Issued July 1969

SOIL SURVEY

Washabaugh County, South Dakota

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
and
UNITED STATES DEPARTMENT OF THE INTERIOR
Bureau of Indian Affairs
In cooperation with
SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION

Major fieldwork for this soil survey was done in the period 1959–60. Soil names and descriptions were approved in 1965. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1961. This survey was made cooperatively by the Bureau of Indian Affairs, the Soil Conservation Service, and the South Dakota Agricultural Experiment Station; it is part of the technical assistance furnished to the Oglala Sioux Tribe and the Jackson-Washabaugh Conservation District.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms and ranches; in selecting sites for roads, ponds, buildings, or other structures; and in appraising the suitability of tracts of land for agriculture, industry, or recreation.

Locating Soils

All the soils of Washabaugh County are shown on the detailed map at the back of this survey. This map consists of many sheets that are made from aerial photographs. Each sheet is numbered to correspond with a number shown on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbol. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information in the survey. This guide lists all of the soils of the county in alphabetic order by map symbol and gives the range site classification, the capability classification, and the windbreak classification in which the soil has been placed. It also gives the page where each soil and each classification is described.

Other classifications can be developed by using the map and information in the text to group soils according to their suitability or limitations for a particular use. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and ranchers and those who work with them can learn about use and management of the soils from the soil descriptions and from the discussions of the range sites and the capability units.

Woodland managers can refer to the section "Use of the Soils for Windbreaks," where the soils of the county are grouped according to their suitability for trees and shrubs.

Game managers, sportsmen, and others can find brief information about the common birds and animals in the section "Wildlife."

Ranchers and others interested in range can find, under "Use of the Soils as Range," groupings of the soils according to their suitability for range and a description of the vegetation on each range site.

Engineers and builders can find, under "Engineering Uses of the Soils," tables that give test data, estimates of soil properties, and information about soil features that affect engineering practices and structures.

Scientists and others can read about how the soils were formed and how they are classified in the section "Formation and Classification of the Soils."

Newcomers in Washabaugh County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the section "General Nature of the County."

Cover Picture: View northward from the top of Medicine Butte.

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UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, AND UNITED STATES DEPARTMENT OF THE INTERIOR, BUREAU OF INDIAN AFFAIRS, IN COOPERATION WITH THE SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION

WASHABAUGH COUNTY is in the southwestern part of South Dakota (fig. 1). It covers an area of about 679,040 acres. Wanblee is the largest town. The county administrative offices are in Kadoka, the county seat of neighboring Jackson County.

All of Washabaugh County is a part of the Pine Ridge Indian Reservation. About 211,000 acres is patented land owned by non-Indians. About 58,000 acres in the northwestern part of the county is owned by the Federal Government. The rest of the acreage is tribal and alloted land administered by the Bureau of Indian Affairs. The patented land and Indian lands are intermingled throughout the country.

This county is in the Great Plains physiographic province. In the southern half the relief is rolling. In the northern part, where there are areas of Badlands, the relief is steep and broken. All of the county is drained by the White River, which forms the northern boundary.

Livestock ranching is the main agricultural enterprise. Only about 10 percent of the county is cropland. Winter wheat and alfalfa are the main crops, but barley, oats, corn, rye, and sorghum also are grown. Scattered wheat farms are in the eastern and northern parts. Except for areas of Barren badlands, almost all the rest of the county is used for grazing and hay.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soils are in Washabaugh County, where they are located, and how they can be used. They went into the county knowing they likely would find many soils they had already seen, and perhaps some they had not. As they traveled over the county, they observed steepness, length, and shape of slopes; size and speed of streams; kinds of native plants or crops; kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down to the rock material that has not been changed much by leaching or by roots of plants.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide uniform procedures. To use this survey efficiently, it is necessary to know the kinds of groupings most used in a local soil classification.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, the major horizons of all the soils of one series are similar in thickness, arrangement, and other important characteristics. Each soil series is usually named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Haverson and Kadoka, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the natural, undisturbed landscape. Soils of one series can differ somewhat in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man.

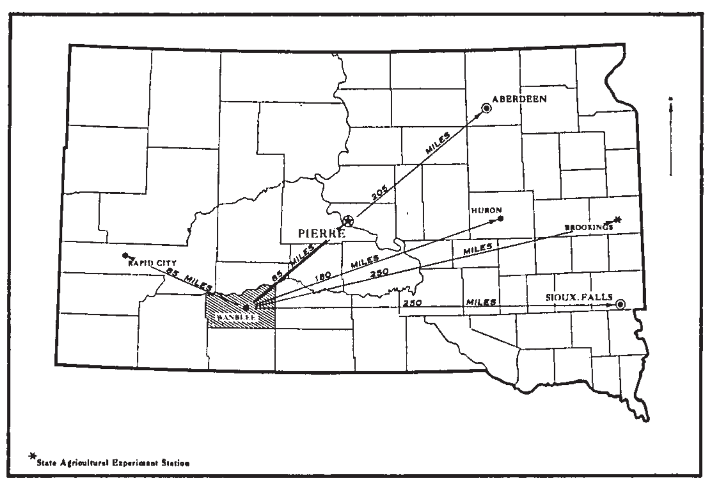

Figure 1.—**Location of Washabaugh County in South Dakota.**

[1] Others who contributed to the soil survey are W. F. JOHNSON and T. B. WILLIAMS, Soil Conservation Service, United States Department of Agriculture.

Many soil series contain soils that differ in texture of their surface layer. According to such differences in texture, separations called soil types are made. Within a series, all the soils having a surface layer of the same texture belong to one soil type. Haverson loam and Haverson silty clay loam are two soil types in the Haverson series. The difference in the texture of their surface layers is apparent from their names.

Some types vary so much in slope, degree of erosion, number and size of stones, or some other feature affecting their use, that practical suggestions about their management could not be made if they were shown on the soil map as one unit. Such soil types are divided into phases. The name of a soil phase indicates a feature that affects management. For example, Kadoka silt loam, 0 to 3 percent slopes, is one of three phases of Kadoka silt loam, a soil type that has a slope range of 0 to 9 percent.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew soil boundaries of the individual soils on aerial photographs. These photographs show buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this survey was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning management of farms and fields, a mapping unit is nearly equivalent to a soil type or a phase of a soil type. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized type or phase.

In preparing some detailed maps, the soil scientists have a problem of delineating areas where different kinds of soils are so intricately mixed or occur in such small individual tracts that it is not practical to show them separately on the map. They show such a mixture of soils as one mapping unit and call it a soil complex. Ordinarily, a soil complex is named for the major kinds of soil in it, for example, Wortman-Wanblee complex.

Another kind of mapping unit is the undifferentiated group, which consists of two or more soils that occur together without regularity in pattern or relative proportion. The individual tracts of the component soils could be shown separately on the map, but the differences between the soils are not enough to merit separation for the objectives of the soil survey. An example is Keith and Ulysses silt loams, 5 to 9 percent slopes.

Still another kind of mapping unit is the soil association. It is a large acreage that consists of two or more soils and is uniform in pattern and proportion of the dominant soils, though these soils may differ greatly. An example is Canyon association, 18 to 40 percent slopes.

Most surveys include areas where the soil material is so rocky, so shallow, or so frequently worked by wind and water that it cannot be classified by soil series. These areas are shown on the map like other mapping units, but they are given descriptive names, such as Alluvial land or Gravelly land, and are called land types.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soils in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soils. Yields under defined management are estimated for selected soils.

Only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups of users, among them farmers, managers of range and woodland, engineers, and homeowners. Grouping soils that are similar in suitability for each specified use is the method of organization commonly used in the soil survey. On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others, then adjust them according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil map at the back of this soil survey shows, in color, the soil associations in Washabaugh County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of farming or other land use. Such a map is not suitable for planning the management of a farm or field, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect management.

The eight associations in Washabaugh County are described in this section. More detailed information about the individual soils in each association can be obtained by studying the detailed soil map and by reading the section "Descriptions of the Soils."

1. Oglala-Canyon-Keith association

Rolling to hilly, well-drained and somewhat excessively drained, loamy soils that are deep and shallow over soft sandstone and deep, silty soils; on uplands

This association is in the southern half of the county. The relief is dominantly rolling. Gently sloping areas occur as small isolated tablelands or as broadened and flattened drainage divides. The hilly areas in the south-central part of the county include a few steep-sided buttes, and those along the southern boundary include canyons and steep-sided valleys.

This association covers a total area of about 140,000 acres, or 20 percent of the county. About 30 percent is made up of Oglala soils, 25 percent of Canyon soils, and 25 percent of Keith soils.

Oglala soils are deep, loamy soils that have a dark-colored surface layer and a light-colored, friable subsoil.

They are on the mid and lower side slopes in rolling to hilly areas.

Canyon soils are shallow, light-colored, calcareous, loamy soils underlain by beds of very fine sand containing layers of limy sandstone or caliche. They are on ridgetops and the steeper slopes.

Keith soils are deep, silty soils that have a dark-colored surface layer and a subsoil of friable to firm silty clay loam. They occur in patches throughout the association, mostly on side slopes in rolling areas but partly on nearly level and gently sloping drainage divides.

Less extensive soils of this association are Colby soils on the tops of well-rounded ridges and knolls; Ulysses soils on the upper part of gentle slopes; Richfield soils on nearly level drainage divides and on foot slopes; Rosebud soils on the more gentle slopes; Goshen soils in upland swales; Hoven soils in small upland depressions; and Alluvial land on narrow bottom lands along intermittent streams.

Most of this association is used for grazing and for hay. About 15 percent is in cultivation. The cultivated areas consist mainly of the more gently sloping Keith and Rosebud soils. Winter wheat is a major crop near Longvalley. Grain and alfalfa are grown in scattered areas as feed for livestock.

Livestock ranches, 2,000 to 20,000 acres in size, are dominant in the association. There are a few farms of as little as 160 acres. These ranches and farms are served mainly by winding ranch trails.

In most of this association, permeable underlying material affects the water-holding ability of farm ponds and sewage lagoons. The slope limits use of the soils for sewage disposal fields. Terracing and other erosion control measures are practical in most cropped areas, except those on Canyon soils. Road construction necessitates many cuts and fills, as well as roadside erosion control measures. Frost heaving is likely to damage highways. The bearing capacity for low buildings is fair to poor.

2. *Kadoka-Epping association*

Gently sloping to hilly, well-drained to excessively drained, silty soils that are deep to shallow over siltstone; on uplands

This association extends from east to west across the central part of the county. It is at a higher elevation than the Badlands association to the north and 50 to 200 feet lower than the Oglala-Canyon-Keith association to the south. The topography is mainly gently sloping to rolling. Hilly areas occur along the larger intermittent streams that flow north to the White River. Small steps and risers, or catsteps, are common in the more rolling areas.

This association covers a total area of about 212,000 acres, or 31 percent of the county. It is about 40 percent Kadoka soils and 30 percent Epping soils.

Kadoka soils are dark-colored, friable, silty soils that have a subsoil of friable to firm silty clay loam. These soils are moderately deep to siltstone. They commonly have slopes of as much as 15 percent.

Epping soils are silty and shallow over siltstone. They are light colored and limy below a depth of 6 inches. They are on the tops of ridges and knolls and on the steeper side slopes.

Less extensive soils of the association are Colby, Keith, Richfield, Ulysses, Goshen, and Hoven soils in scattered patches where silty loess overlies siltstone; Anselmo and Tuthill soils in patches near Wanblee; Huggins soils on upland divides in the eastern part of the county; Wortman and Wanblee soils on foot slopes and in valleys on uplands; and Alluvial land along intermittent streams. Outcrops of siltstone occur with Epping soils on the steeper slopes.

Most of this association is in native grass and is used for grazing. About 8 percent, much of it consisting of Kadoka and Keith soils, is cropped. Winter wheat is the main cash crop. Grain and alfalfa are grown as feed for livestock.

Farms and ranches in this association range from 160 to 20,000 acres in size. They are served by a few roads on section lines east of Wanblee and a few winding ranch roads that lead to gravel roads or hard-surfaced roads.

In most of this association, farm ponds hold water satisfactorily, but a seal blanket is needed in some areas. Terracing and other erosion control measures are practical in most cropped areas, except those on Epping and Huggins soils. Roadside erosion control measures are needed along most highways. Frost heaving is likely to damage highways. The bearing capacity for low buildings is poor.

3. *Samsil-Pierre association*

Gently sloping to hilly, well-drained to excessively drained, clayey soils that are shallow and moderately deep over clay shale; on uplands

This association is near the White River and its tributaries, in the northeastern part of the county. The areas are rough and are broken by numerous drainageways at rather close intervals. Some of these drainageways are gullied and have vertical walls.

This association covers a total area of about 25,000 acres, or 4 percent of the county. It is about 40 percent Samsil soils and 30 percent Pierre soils.

Samsil soils are light-colored, firm, calcareous clays that are shallow to shale, which crops out in many areas. These soils are on ridges, points, and the steeper slopes.

Pierre soils have a moderately dark colored, granular surface layer and a subsoil of very firm, blocky clay. The depth to clay shale ranges from 18 to 40 inches. These soils are on the longer and gentler slopes.

Less extensive soils of this association are Hisle and Swanboy soils on foot slopes and fans along intermittent streams and drainageway, and Kyle soils on low terraces. There are scattered areas of Gravelly land and Terrace escarpments.

All of this association is in native grass and is used for grazing. Most of it is part of ranches that are partly in adjacent soil associations. Most areas are accessible by ranch trails.

In most of this association, farm ponds hold water satisfactorily. Pond sites in the steeper areas are limited by excessive sedimentation, a lack of natural spillways, and unstable material. Earthen structures and foundations for low buildings are affected by the high shrink-swell potential of the soils. Highway construction is costly because of the topography and the likelihood of erosion.

4. *Badlands association*

Barren badlands intermingled with clayey and loamy soils; in basins and on escarpments, buttes, tablelands, and mesas

This association is mainly in the northern part of the county. Natural geologic erosion has cut into the soft, silty to clayey formations and has carved Barren badlands consisting of small, grass-covered tablelands and mesas, eroded walls and escarpments, and basins in which there are light-colored, calcareous soils and scattered eroded buttes. The relief ranges from nearly level to almost vertical and is cut by numerous drainageways that are gullied and have vertical walls.

This association covers a total area of about 185,000 acres, or 27 percent of the county. It is about 40 percent Badlands and Barren badlands and 15 percent Clayey land and Loamy land.

Barren badlands occur as broad eroded areas that are more than 75 percent bare. Badlands are about 25 to 75 percent bare. Intermingled with them are mixed silty soils that are grass covered.

Clayey land and Loamy land are dominant in the basins. Clayey land consists of mixed, calcareous, clayey soils. Loamy land consists of mixed loamy and silty soils, most of which are high in lime content.

Less extensive in this association are Hisle, Swanboy, and Wanblee soils in basins; Kadoka and Epping soils on the grass-covered parts of escarpments; and Anselmo, Colby, Keith, Richfield, Tuthill, Ulysses, and Valentine soils on isolated tablelands and mesas. Also in the association are scattered areas of Alluvial land, Gravelly land, and Terrace escarpments.

Almost all of this association is used for grazing. Only about 1 percent is in cultivation. Alfalfa and feed grain are the main crops.

Ranches range up to 30,000 acres in size. One main highway crosses the area, and there are winding ranch trails in the rest. Some parts are accessible only by horseback.

Runoff water carries so much sediment that farm ponds are rapidly filled. Sediment catchment structures may prolong the life of ponds, but maintenance is costly. Spillways gully readily. Earthen structures and foundations for low buildings are affected by instability, poor bearing capacity, moderate to high shrink-swell potential, poor shear strength, and high runoff yield. High bridges and large culverts are needed to pass peak flows of runoff.

5. *Tuthill-Keith-Richfield association*

Nearly level to undulating, well-drained, deep, loamy soils; on tablelands and terraces

This association occurs in nine separate tracts and is mainly in the northern part of the county. It is made up of tablelands and high terraces 100 to 200 feet above the flood plain of the White River. The soils have been modified, in places, by soil blowing and deposition. Stratified sand and gravel typically occur below a depth of 4 feet.

This association covers a total area of about 75,000 acres, or 11 percent of the county. About 30 percent of the acreage is made up of Tuthill soils, and 25 percent is made up of Keith and Richfield soils.

Tuthill soils have a surface layer of dark-colored fine sandy loam to loam and a subsoil of friable to firm sandy clay loam. These soils are undulating and are dominant in the northwestern and central parts of the county.

Keith and Richfield soils are deep, dark-colored, silty soils that have a subsoil of friable to firm silty clay loam. They are dominant in the nearly level areas, especially in the northeastern part of the county.

Anselmo, Manter, and Valentine soils in the central and northwestern parts of the county make up 30 percent of the association, and there are smaller areas of Gravelly land and of Colby, Goshen, Hoven, Mosher, and Ulysses soils.

About 40 percent of this association is in cultivation; some areas in the northeastern part are about 70 percent cropland. Winter wheat is the main crop, but oats, barley, corn, sorghum, and alfalfa also are grown. One area in the northwestern part was formerly a bombing range and is used only for grazing.

In this association are a few farms, primarily wheat farms, less than 1,000 acres in size. Some tracts of cropland are parts of livestock ranches that are headquartered in the adjacent soil associations. Most areas are accessible by roads and trails.

In most of this association, permeable underlying material affects the water-holding capability of farm ponds and sewage lagoons. Shallow wells and springs are the best sources of water for domestic use and for livestock. Terraces and diversion ditches are practical in most areas, but possibly not in areas of Altvan soils, which have sand and gravel at a depth of less than 40 inches. All except Keith and Richfield soils have good stability and bearing capacity and are suitable for earthen structures, highways, and foundations for low buildings. Most areas have only slight limitations for septic tanks and tile sewage systems, but ground water could be contaminated locally. Sand and gravel occur at a depth of 2 to 10 feet in most areas, but tests are necessary to determine the suitability of these materials for use in construction.

6. *Valentine association*

Undulating to rolling, excessively drained, deep, sandy soils; on uplands

This association is in the southeastern part of the county, between two forks of Pass Creek. The relief is undulating to rolling. Short-sloped ridges and knolls rise about 10 to 30 feet above intervening pockets or swales.

This association covers a total area of about 5,000 acres, or less than 1 percent of the county. It is about 75 percent Valentine soils.

Valentine soils have a surface layer of light-colored loamy fine sand to sand. They are underlain by light-colored, loose sand.

Less extensive soils are Anselmo, Manter, and Tuthill soils on the longer and more gentle slopes; Altvan soils on small, nearly level benches along Pass Creek; Wortman and Wanblee soils on foot slopes and flats on the edges of the association; and Wet alluvial land along Pass Creek and its tributaries.

All of this association is used for grazing. Small tracts were once cultivated, but they have been damaged by soil blowing and have been returned to grass.

The soils in this association are too sandy to be suitable for terraces or for farm ponds. Wells are the best source of water for domestic use and for livestock. Septic tanks and tile sewage-disposal systems function satisfactorily. Soil blowing hinders road construction. The bearing capacity for building foundations and for road fill is good.

7. *Wortman-Wanblee association*

Nearly level and gently sloping, moderately well drained and somewhat poorly drained claypan soils that are moderately deep over siltstone; in swales and on foot slopes, fans, and stream flats

This association is in the southeastern part of the county, along Pass Creek, Buzzard Creek, and the tributaries of these. The areas are long and as much as 1½ miles wide in places. The surface is uneven in most places, and there are depressions up to 15 feet in diameter and 2 to 12 inches deep. In some areas the water table is at a depth of 4 to 10 feet.

This association covers a total area of about 18,000 acres, or 3 percent of the county. It is 75 percent Wortman and Wanblee soils.

These soils are closely associated. Wortman soils are on mounds, and Wanblee soils are mostly in depressions. Wortman soils are darker colored than Wanblee soils and have a thicker surface layer and subsoil. Both soils are underlain either by siltstone or silt that contains fragments of siltstone.

Less extensive soils in this association are Altvan and Keith soils in the better drained areas; Epping, Huggins, and Kadoka soils on small islands; Mosher and Minatare soils in the lower areas; and Alluvial land and Wet alluvial land on narrow flood plains.

Almost all of this association is used for grazing. A few small tracts are cropped, but the response to management generally is unsatisfactory because Wanblee soils have poor tilth and salts occur in the root zone of both Wortman and Wanblee soils.

In most of this association, farm ponds hold water satisfactorily. Earthen structures and road grades are affected by instability of the soil material. Poor bearing capacity limits the suitability of the soils for foundations of low buildings.

8. *Alluvial land-Haverson association*

Nearly level and level, loamy soils and mixed alluvial soils; on bottom lands and low terraces

This association is on bottom lands and low terraces along the White River and its tributaries.

The total area of this association is about 20,000 acres, or 3 percent of the county. About 50 percent is made up of Alluvial land, and about 40 percent is made up of Haverson soils.

Alluvial land consists of mixed soil material and varying amounts of Haverson soils. It is on the lower flood plain of the White River and in areas dissected by the tributary streams.

Haverson soils are light-colored, calcareous loams and silt loams. They are underlain by stratified alluvium consisting of very fine sand, silt, and silty clay.

Less extensive soils in this association are Kyle and Swanboy soils on flats and fans at the outer edge of stream valleys.

About 25 percent of this association is in crops, mainly alfalfa. Much of the rest is used for hay and for winter grazing. A few small tracts are irrigated with water pumped from the White River or from small storage reservoirs along the tributary streams.

This association is a major feed base and wintering ground for livestock ranches in the northern part of the county. Scattered thickets of trees and shrubs help to protect game animals and livestock. A few ranches are headquartered here. Most areas are accessible by roads and ranch trails.

Farm ponds in these soils generally need a seal blanket. Shallow wells and flowing streams are the main sources of water for livestock. Floodwaters laden with silt and debris damage engineering structures in some years.

Descriptions of the Soils

In this section the soils of Washabaugh County are described in detail. The procedure is to describe first a soil series, and then the mapping units in that series. The description of each soil series includes a description of a profile that is considered representative of all the soils of the series. If the profile of a given mapping unit differs from this typical profile, the differences are stated in the description of the mapping unit, unless they are apparent from the name of the mapping unit. Thus, to get full information on any one mapping unit, it is necessary to read both the description of that unit and the description of the soil series to which the unit belongs.

As explained in the section "How This Survey Was Made," a few of the mapping units, Alluvial land and Gravelly land, for example, are not part of any soil series, but they are listed in alphabetic order along with the soil series.

The approximate acreage and proportionate extent of each mapping unit are shown in table 1. Many terms used in describing soil series and mapping units are defined in the Glossary, and some are defined in the section "How This Survey Was Made." At the back of this survey is the "Guide to Mapping Units," which lists all the mapping units in the county and shows the range site, the capability unit, and the windbreak group in which each has been placed.

Alluvial Land

Alluvial land (0 to 3 percent slopes) (Aa) is on bottom lands in nearly all parts of the county. It generally is broken into long, narrow areas by meandering stream channels and is subject to flooding. The material ranges from almost white recent alluvium to dark-colored alluvium. It ranges from loamy sand to clay and generally is layered with material of contrasting texture. Included in the areas mapped are bodies of Haverson soils and of Badlands consisting of vertical-walled channels and bare cut banks.

The native vegetation consists of sparse to good stands of tall and mid grasses. Clumps of native trees and shrubs protect livestock and game animals in winter. Most areas

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Area	Extent
	Acres	*Percent*
Alluvial land	30, 206	4. 4
Altvan loam, 0 to 3 percent slopes	1, 201	. 2
Altvan loam, 3 to 9 percent slopes	3, 949	. 6
Anselmo-Valentine complex, 5 to 20 percent slopes	36, 375	5. 3
Badlands	43, 580	6. 4
Barren badlands	23, 927	3. 5
Canyon association, 18 to 40 percent slopes	17, 498	2. 6
Canyon-Rock outcrop association	5, 797	. 9
Clayey land	13, 938	2. 1
Epping complex, 9 to 40 percent slopes	19, 424	2. 9
Epping-Kadoka silt loams, 9 to 18 percent slopes	43, 145	6. 4
Epping-Rock outcrop complex	18, 111	2. 7
Goshen silt loam, 0 to 3 percent slopes	3, 885	. 6
Gravelly land	15, 639	2. 3
Haverson loam, high, 0 to 3 percent slopes	3, 673	. 5
Haverson loam, low, 0 to 3 percent slopes	3, 802	. 6
Haverson silty clay loam, 0 to 3 percent slopes	1, 407	. 2
Hisle clay	2, 719	. 4
Hoven silt loam	965	. 1
Huggins silt loam, 0 to 3 percent slopes	1, 460	. 2
Kadoka silt loam, 0 to 3 percent slopes	2, 496	. 4
Kadoka silt loam, 3 to 5 percent slopes	17, 963	2. 6
Kadoka silt loam, 5 to 9 percent slopes	23, 545	3. 5
Kadoka-Epping silt loams, 3 to 9 percent slopes	29, 689	4. 4
Kadoka-Huggins complex, 3 to 9 percent slopes	9, 376	1. 4
Keith silt loam, 0 to 3 percent slopes	9, 376	1. 4
Keith silt loam, 3 to 5 percent slopes	9, 633	1. 4
Keith-Colby silt loams, 9 to 12 percent slopes	8, 582	1. 3
Keith-Colby silt loams, 12 to 25 percent slopes	9, 223	1. 4
Keith-Rosebud silt loams, 3 to 5 percent slopes	3, 492	. 5
Keith-Rosebud-Canyon complex, 5 to 9 percent slopes	55, 351	8. 1
Keith and Ulysses silt loams, 5 to 9 percent slopes	14, 400	2. 1
Kyle clay, alkali, 0 to 3 percent slopes	589	. 1
Loamy land	12, 096	1. 8
Mosher-Minatare complex	1, 471	. 2
Oglala-Canyon complex, 9 to 18 percent slopes	18, 152	2. 7
Pierre clay, 3 to 9 percent slopes	1, 560	. 2
Pierre-Samsil clays, 9 to 25 percent slopes	2, 266	. 3
Richfield and Keith silt loams, 0 to 3 percent slopes	14, 379	2. 1
Richfield and Keith silt loams, 3 to 9 percent slopes	23, 790	3. 5
Samsil-Pierre clays, 9 to 25 percent slopes	10, 783	1. 6
Samsil-Shale outcrop complex	4, 597	. 7
Swanboy clay	800	. 1
Terrace escarpments	4, 103	. 6
Tuthill and Anselmo fine sandy loams, 0 to 3 percent slopes	2, 913	. 4
Tuthill and Anselmo fine sandy loams, 3 to 9 percent slopes	24, 062	3. 5
Tuthill and Manter soils, 0 to 3 percent slopes	3, 449	. 5
Tuthill and Manter soils, 3 to 5 percent slopes	17, 128	2. 5
Tuthill and Manter soils, 5 to 9 percent slopes	11, 448	1. 7
Valentine sand	7, 981	1. 2
Wanblee soils	2, 354	. 3
Wet alluvial land	1, 466	. 2
Wortman-Wanblee complex	29, 335	4. 3
Water	491	. 1
Total	679, 040	100. 0

are in native grass and are used for grazing and hay. A few areas are cultivated, mainly to alfalfa, and some are used as garden plots. Many areas otherwise suitable for cultivation are either too small or are inaccessible to farm machinery. Flooding, which occasionally damages fences and deposits sediments and trash, is the main hazard. The use of the areas for grazing, hay, and wildlife minimizes flood damage. (Overflow range site, capability unit VIw-1; windbreak group 4)

Altvan Series

The Altvan series consists of nearly level and gently sloping, friable, dark-colored, loamy soils that are moderately deep over gravel. These soils formed in loamy material over gravel and are on terraces and benches.

In a typical profile, the surface layer is about 8 inches thick. The upper half is dark grayish-brown loam of weak platy and granular structure. The lower half is dark-gray silt loam of weak subangular blocky and granular structure. This layer is soft when dry and friable or very friable when moist.

The subsoil is about 18 inches thick. The upper 12 inches is grayish-brown silty clay loam of weak to moderate prismatic and subangular blocky structure. It is hard when dry and friable to firm when moist. The lower 6 inches is light brownish-gray sandy clay loam of weak to moderate subangular blocky structure. It is hard when dry and firm when moist.

The underlying material is calcareous, light-gray gravelly sandy loam. It is structureless and is loose when dry and very friable when moist.

Altvan soils are well drained, have moderate fertility, and are easy to work. Surface runoff is slow to medium; permeability is moderate in the upper part and moderately rapid to rapid in the underlying material; and the water-holding capacity is moderate.

The native vegetation consists of mid and short grasses. Many of the nearly level areas are cultivated. Winter wheat, spring-sown grain, corn, and alfalfa are the main crops.

Profile of Altvan loam, 0 to 3 percent slopes, in native grass pasture, located 1,840 feet south and 50 feet west of the NE. corner of sec. 18, T. 40 N., R. 34 W.

A11—0 to 4 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) when moist; weak, medium, platy structure breaking to weak, medium, granular; soft when dry, very friable when moist; neutral; abrupt, smooth boundary.

A12—4 to 8 inches, dark-gray (10YR 4/1) silt loam, black (10YR 2/1) when moist; weak, coarse and medium, subangular blocky structure breaking to weak, medium, granular; soft when dry, friable when moist; neutral; abrupt, smooth boundary.

B21t—8 to 12 inches, grayish-brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, prismatic structure breaking to moderate, medium and fine, subangular blocky;

slightly hard when dry, friable when moist; thin patchy clay films; worm casts common; mildly alkaline; clear, smooth boundary.

B22t—12 to 20 inches, grayish-brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, prismatic structure breaking to moderate, medium and fine, subangular blocky; hard when dry, firm when moist; thin continuous clay films; many worm casts; mildly alkaline; clear, smooth boundary.

B3—20 to 26 inches, light brownish-gray (10YR 6/2) sandy clay loam, dark grayish brown (10YR 4/2) when moist; weak to moderate, coarse to medium, subangular blocky structure; hard when dry, firm when moist; thin patchy clay films; mildly alkaline; abrupt, smooth boundary.

IIC—26 to 40 inches, light-gray (10YR 7/2) gravelly sandy loam, brown (10YR 5/3) when moist; structureless; loose when dry, very friable when moist; rounded pebbles up to 1½ inches in diameter; calcareous; moderate alkaline.

The A horizon ranges from 3 to 10 inches in thickness and from loam to silt loam in texture. The B horizon ranges from 10 to 20 inches in thickness and includes silty clay loam, clay loam, and sandy clay loam textures. The depth to gravelly sandy loam or sand and gravel ranges from 20 to 40 inches. This material is noncalcareous in some places.

Altvan soils have less sand in the surface layer and subsoil than Tuthill soils and more gravel in the underlying material. They differ from Keith soils in having gravel at a depth of less than 40 inches.

Altvan loam, 0 to 3 percent slopes (AlA).—Most areas of this soil are on terraces and benches along Pass Creek, in the southeastern part of the county. They are mostly less than 150 acres in size. The profile is the one described for the series. Included in the areas mapped are small bodies of Tuthill soils on slight rises.

This soil is used as cropland and as range. Winter wheat is the most common crop, but spring-sown grain, corn, sorghum, and alfalfa also are grown. The coarse-textured material in the substratum causes this soil to be slightly droughty, and as a result, moisture conservation is the main management problem. (Silty range site, capability unit IIIs–1, windbreak group 2)

Altvan loam, 3 to 9 percent slopes (AlC).—This soil is on terrace fronts in the northern and southeastern parts of the county. It occurs as long, narrow areas that generally are less than 150 acres in size. The slopes normally are short and irregular.

The surface layer and subsoil are thinner than those described as typical for the series. The underlying material is gravelly at a depth of 20 to 25 inches in the southeastern part of the county and is sandy or gravelly at a depth of about 30 inches in the northern part.

Included in the areas mapped are areas of shallow or gravelly soil material similar to that in Gravelly land. Also included are areas of Manter and Tuthill soils, on the upper part of slopes. Inclusions make up less than 15 percent of any given area of this soil.

This soil is used as cropland and as range. Most areas are in native grass, but winter wheat, spring-sown grain, corn, sorghum, and alfalfa are grown. Water erosion and soil blowing are hazards in cultivated areas. Droughtiness is a moderate limitation. The conservation of moisture and the control of erosion are major management problems. (Silty range site, capability unit IVe–5, windbreak group 2)

Anselmo Series

The Anselmo series consists of deep, nearly level to rolling, very friable, dark-colored, moderately coarse textured soils on uplands. These soils formed in wind-worked sand that contained enough silt to be slightly coherent (fig. 2).

In a typical profile, the surface layer is about 8 inches thick. It is grayish-brown sandy loam of weak platy, granular, and subangular blocky structure. It is soft when dry and very friable when moist.

Below the surface layer is about 12 inches of dark grayish-brown sandy loam of weak prismatic structure. This layer also is soft when dry and very friable when moist.

The underlying material is loose, pale-brown loamy sand and sand. It has weak subangular blocky structure in the upper part and is structureless in the lower part. Below a depth of 55 inches is calcareous sand that contains a few rounded pebbles up to 1 inch in diameter.

Anselmo soils are well drained and have moderate fertility. Surface runoff is slow, and permeability is moderately rapid. Soil blowing is a hazard when the surface is bare.

Figure 2.—**Profile of an Anselmo sandy loam.**

The native vegetation consists of a mixture of tall, mid, and short grasses, most areas of which are used for grazing and hay crops. Scattered small areas are cultivated, mainly to spring-sown grain, corn, and alfalfa. Some areas that were once cultivated are now seeded to tame grass.

Profile of an Anselmo sandy loam in native grass pasture, located 2,490 feet south and 100 feet east of the NW. corner of sec. 27, T. 43 N., R. 39 W.

A11—0 to 4 inches, grayish-brown (10YR 5/2) sandy loam, dark brown (10YR 3/3) when moist; weak, coarse, platy structure breaking to weak, fine, granular; soft when dry, very friable when moist; neutral; abrupt, smooth boundary.

A12—4 to 8 inches, grayish-brown (10YR 5/2) sandy loam, very dark brown (10YR 2/2) when moist; weak, fine, subangular blocky structure breaking to weak, fine, granular; soft when dry, very friable when moist; neutral; abrupt, smooth boundary.

AC—8 to 20 inches, dark grayish-brown (10YR 4/2) sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, medium and fine, prismatic structure; soft when dry, very friable when moist; neutral; clear, smooth boundary.

C1—20 to 36 inches, pale-brown (10YR 6/3) loamy sand, brown (10YR 4/3) when moist; weak, medium and fine, subangular blocky structure; soft when dry, loose when moist; neutral; gradual, smooth boundary.

C2—36 to 55 inches, pale-brown (10YR 6/3) sand, brown (10YR 4/3) when moist; structureless; loose; mildly alkaline; gradual boundary.

C3—55 to 60 inches, pale-brown (10YR 6/3) sand, brown (10YR 5/3) when moist; structureless; loose; few rounded pebbles up to 1 inch in diameter; calcareous; moderately alkaline.

In places the A horizon is loamy sand or loamy fine sand. The depth to the C horizon ranges from 8 to 30 inches. This horizon generally is free of lime but in places is calcareous below a depth of 36 inches. In the northern part of the county the underlying sand is stratified in places with thin layers of coarse sand containing a few, fine, rounded pebbles. A dark-colored buried soil is present in places.

Anselmo soils are darker colored and less sandy than Valentine soils. They lack the distinct subsoil layers of Manter and Tuthill soils.

Anselmo-Valentine complex, 5 to 20 percent slopes (AvD).—Anselmo and Valentine soils each make up 40 to 60 percent of this complex. The Anselmo soil has a profile similar to the one described for this series, and the Valentine soil has a profile similar to the one described for the Valentine series. This complex is on uplands and is undulating to rolling. The areas range up to 1,000 acres in size. Many extend in a northwest-southeast direction. The Anselmo soil generally occurs on the longer, more uniform slopes, and the Valentine soil on knolls and the shorter slopes of ridges.

Included in the areas mapped are small bodies of Manter and Tuthill soils on small flats and in swales. On ridges in the northern part of the county are small inclusions of sandy loam and sand that are shallow to gravel. Inclusions make up less than 10 percent of any given area.

Most of this complex is in native grass and is used for grazing and hay. A few small areas are cultivated, mainly to spring-sown grain, corn, and alfalfa. Some of the areas that were once cultivated are now either in tame grass or native grass. The pattern of occurrence of Valentine soils makes growing of crops impractical. (Anselmo in Sandy range site, capability unit VIe–2, windbreak group 1; Valentine in Sands range site, capability unit VIe–2, windbreak group 7)

Badlands

Badlands (Ba) are mainly in the northern part of the county. The slope range is 3 to 50 percent. Part of this land type occurs in the form of escarpments and walls that are partly stabilized with vegetation, and part occurs in basins where gullies have cut through gentle slopes at close intervals. Barren badlands make up 25 to 75 percent of a given area, Loamy land 15 to 50 percent, and Clayey land 5 to 40 percent. Clayey land and Loamy land occupy low mesas in the basins. Included in the areas mapped are bodies of Hisle, Swanboy, and Wanblee soils in basins and of Colby, Epping, Kadoka, and Ulysses soils on escarpments. Inclusions make up less than 20 percent of any given area of this land type.

Badlands have some value for grazing, but the grass-covered areas are small and scattered. Providing water for livestock is a problem in some areas. Proper range management is needed to help control erosion and prevent the expansion of barren areas. (Barren badlands in capability unit VIIIs–1, not placed in a range site or a windbreak group; Clayey land in Clayey range site, capability unit VIe–1, windbreak group 3; Loamy land in Silty range site, capability unit VIe–1, windbreak group 2)

Barren badlands (Bk) occur as buttes, walls, gullied areas, and eroded floors in the northern part of the county. The slope range is 3 to 50 percent. Bare, eroding exposures of geologic material make up at least 75 percent of a given area. Included in the areas mapped are bodies of soils and land types similar to those included with Badlands.

The grass-covered areas of this land type are so small and scattered that grazing is not practical. (Capability unit VIIIs–1, not placed in a range site or windbreak group)

Canyon Series

This series consists of shallow, gently sloping to hilly, friable, light-colored, medium-textured, calcareous soils. These soils are on ridges and the tops of knolls on rolling uplands and on the steep side slopes of buttes and V-shaped canyons. They are mainly in the southern part of the county.

In a typical profile, the surface layer, about 4 inches thick, is light brownish-gray loam of weak granular structure. It is soft when dry and very friable when moist. Below the surface layer is about 5 inches of calcareous, light-gray loam that has weak granular structure. It also is soft when dry and very friable when moist.

The underlying material is calcareous, light-gray loam that is structureless and is soft when dry and very friable when moist. It contains many bits and fragments of calcareous sandstone. Slightly hard to hard, calcareous sandstone occurs at a depth of 16 inches.

Canyon soils are somewhat excessively drained and have low fertility. Surface runoff is medium to rapid, permeability is moderately rapid, and the water-holding capacity is low. Water erosion and soil blowing are hazards when the vegetation is disturbed.

The native vegetation consists of mid and short grasses and scattered, thin stands of ponderosa pine. Small spots of Canyon soils occur within larger areas of Rosebud and Keith soils and are cropped along with those soils.

Profile of a Canyon loam, located 2,090 feet north and 1,360 feet west of the SE. corner of sec. 11, T. 40 N., R. 40 W.

A1—0 to 4 inches, light brownish-gray (10YR 6/2) loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; mildly alkaline; abrupt, wavy boundary.

AC—4 to 9 inches, light-gray (10YR 7/2) loam, dark grayish brown (10YR 4/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; calcareous; moderately alkaline; clear boundary.

C—9 to 16 inches, light-gray (10YR 7/2) loam, grayish brown (10YR 5/2) when moist; structureless; soft when dry, very friable when moist; many fine fragments of fine-grained sandstone; calcareous; moderately alkaline; abrupt boundary.

R—16 to 25 inches, light-gray (10YR 7/2) semi-indurated sandstone, grayish brown (10YR 5/2) when moist; bedded; calcareous; strongly alkaline.

The A1 horizon ranges from 1 to 5 inches in thickness and includes loam, very fine sandy loam, and silt loam textures. It is calcareous in places. The AC horizon ranges from 3 to 12 inches in thickness and, in places, has weak subangular blocky structure. In some places the A1 and AC layers contain fragments of sandstone. The C horizon ranges up to 8 inches in thickness. It is typically loam but includes silt loam in some places. Fragments of resistant sandstone and siltstone are common and make up less than 30 percent of the C horizon. The R horizon occurs at a depth of 8 to 24 inches. It consists of soft very fine sands and silts interbedded with thin layers of hard, calcareous sandstone, which ranges from white to very pale brown and influences the color of the soils.

Canyon soils are lighter colored than Rosebud soils and are shallower and have less distinct horizons. They contain less silt than Epping soils.

Canyon association, 18 to 40 percent slopes (CaF).—Canyon soils make up 50 to 80 percent of this association, and Oglala and Rosebud soils 20 to 50 percent. These soils are on narrow ridges and steep side slopes of intermittent streams in the southern part of the county. The areas range up to 1,000 acres in size and are irregular to oblong in shape. Canyon soils are on ridgetops and the upper part of steep slopes. Oglala soils are on the mid and lower slopes, and Rosebud soils are on small flattened drainage divides and mid slopes. Outcrops of sandstone, mostly less than 1 acre in size, are on the upper part of slopes. In most places Oglala and Rosebud soils have a slope of less than 20 percent. They occur in bodies up to 20 acres in size. The surface layer of these soils is dominantly silt loam and loam.

Included in the areas mapped are bodies of Colby, Epping, Goshen, Keith, and Ulysses soils. Colby, Keith, and Ulysses soils are on the more rounded ridgetops, mostly on the south-facing and east-facing slopes; Goshen soils are on foot slopes and on the bottoms of drainageways; Epping soils are on the shoulders of drainageways that dissect the lower elevations.

All of this association is in native grass and is used for grazing. The combination of steep slopes and dominantly shallow soils precludes cultivation. Gullies form easily when the vegetation is disturbed, and consequently the native grass cover should be maintained. Seeding and other mechanical measures are not practical. (Canyon in Shallow range site, capability unit VIIs–2, not placed in a windbreak group; Oglala and Rosebud in Silty range site, capability unit VIe–1, windbreak group 2)

Canyon-Rock outcrop association (18 to 40 percent slopes) (Cc).—Canyon soils make up 40 to 70 percent of this association, Rock outcrop 15 to 25 percent, and Oglala and other soils 15 to 35 percent. All of these are on the steep side slopes of buttes and V-shaped canyons. They are in the southern part of the county. The areas are more broken and have more irregular relief and greater amounts of Rock outcrop than areas of Canyon association, 18 to 40 percent slopes. Canyon soils and Rock outcrop are closely intermingled on the upper part of steep slopes. Rock outcrop occurs also as almost vertical exposures of sandstone on the sides of deeply dissected drainageways. Oglala soils are on the mid and lower slopes, where the gradient is mostly less than 20 percent.

Included in the areas mapped are small bodies of Colby, Epping, Goshen, Rosebud, and Ulysses soils. Goshen soils are on foot slopes; Colby and Ulysses soils are principally on slopes that face east and south; Rosebud soils, which are on mid slopes, occur in places as small drainage divides between drainage heads. Epping soils are near the base of slopes where siltstone crops out. Also included are narrow strips of Wet alluvial land at the bottom of ravines.

All of this association is used for grazing. Scattered stands of pine in and around areas of Rock outcrop protect livestock and game animals and are sources of fenceposts and firewood. Gullies form easily where the vegetation has been disturbed. Proper range use is the only practical way to control erosion. Because of the steep, irregular slopes and the rock outcrops, seeding and other mechanical measures are not practical. (Canyon in Shallow range site, capability unit VIIs–2, not placed in a windbreak group; Rock outcrop in capability unit VIIIs–1, not placed in a range site or windbreak group)

Clayey Land

Clayey land (0 to 6 percent slopes) (Cy) consists of mixed clayey soil material in Badland basins in the northern part of the county. It generally is surrounded and dissected by gullies that carry away most of the runoff and sediment. The color, texture, and structure vary. The surface layer generally is darkened by organic matter to a depth of 2 to 6 inches. Beneath this layer is light-colored material that ranges from silty clay loam to silty clay in texture and has weak blocky structure. The horizontal breakage planes are more distinct than the vertical ones. The underlying material ranges from silt loam to silty clay and is layered, in most places, with bands of contrasting texture.

Included in the areas mapped are small bodies of Loamy land and of Hisle, Swanboy, and Wanblee soils. These inclusions make up less than 25 percent of any given area.

Almost all areas are in native grass pasture or hay. A few are in crops, mainly spring-sown grain, sorghum, alfalfa, and tame grasses. These soils are high in lime content. They take in water slowly and are likely to erode if disturbed. A good grass cover should be maintained.

Providing adequate water for livestock is a problem in some areas. (Clayey range site, capability unit VIe-1, windbreak group 3)

Colby Series

This series consists of friable, light-colored, calcareous soils on uplands. These soils formed in uniform-textured loess on the tops of well-rounded ridges and knolls. They occur in most parts of the county.

In a typical profile, the surface layer is about 2 inches thick. It is pale-brown silt loam of weak platy and granular structure. It is soft when dry and friable when moist. Below the surface layer is about 22 inches of calcareous, pale brown and very pale brown silt loam of weak prismatic and subangular blocky structure. This material is slightly hard when dry and friable when moist. In the lower part there are fine white streaks of soft lime.

The underlying material is calcareous, very pale brown silt loam that is structureless and is soft when dry and friable when moist. It contains many, fine, white streaks or threads of soft lime.

Colby soils are somewhat excessively drained. They are high in lime content, low in organic-matter content, and low in fertility. They are easy to work and respond well to management. Surface runoff is medium to rapid, permeability is moderate, and the water-holding capacity is high. Water erosion and soil blowing are hazards.

The native vegetation consists of mid and short grasses. Most areas are used for grazing. Some of the more gently sloping areas are in crops, mainly winter wheat.

Colby soils in Washabaugh County are mapped only with Keith soils.

Profile of a Colby silt loam in native grass pasture, located 2,320 feet east and 830 feet north of the SW. corner of sec. 31, T. 41 N., R. 39 W.

A1—0 to 2 inches, pale-brown (10YR 6/3) silt loam, dark grayish brown (10YR 4/2) when moist; weak, fine, platy structure breaking to very fine granular; soft when dry, friable when moist; mildly alkaline; abrupt, smooth boundary.

AC1—2 to 5 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; weak, medium, prismatic structure breaking to weak, coarse, subangular blocky; silghtly hard when dry, friable when moist; calcareous; moderately alkaline; clear, smooth boundary.

AC2—5 to 24 inches, very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) when moist; weak, coarse, prismatic structure breaking to weak, coarse, subangular blocky; slightly hard when dry, friable when moist; calcareous; many, fine, soft lime segregations; moderately alkaline; gradual, smooth boundary.

C—24 to 60 inches, very pale brown (10YR 7/3) silt loam, pale brown (10YR 6/3) when moist; structureless; soft when dry, friable when moist; few, fine, brownish-yellow (10YR 6/6) iron stains, dark yellowish brown (10YR 4/4) when moist; calcareous; many, fine, soft lime segregations; moderately alkaline.

The A1 horizon ranges from 1 to 4 inches in thickness and is dark colored in places. The AC horizon ranges from 3 to 24 inches in thickness and either has weak structure or is structureless. These soils are calcareous within 5 inches of the surface, but lime segregations are not present in all places.

Colby soils are lighter colored than Keith and Ulysses soils and are calcareous nearer the surface. They lack the clayey subsoil present in the Keith soils. The underlying material is softer than that of Canyon and Epping soils and lacks fragments of sandstone and siltstone.

Epping Series

This series consists of shallow, gently sloping to hilly, friable, light-colored, calcareous soils underlain by bedded silt and siltstone. These soils are on uplands and occur in most parts of the county.

In a typical profile, the surface layer, about 4 inches thick, is light brownish-gray silt loam of weak platy and granular structure. It is soft when dry and friable when moist and contains many bits and fragments of siltstone.

The underlying material is calcareous, light-gray silt loam. It is soft when dry and friable when moist. It is underlain, at a depth of about 7 inches, by interbedded calcareous, pinkish-gray silt and soft siltstone. Lime coats are on the horizontal breakage planes.

Epping soils are somewhat excessively drained to excessively drained. They are low in organic-matter content, low in fertility, and high in lime content. Surface runoff is rapid, and permeability is moderately slow. Water erosion and soil blowing are hazards.

The native vegetation consists of short and mid grasses, most areas of which are used for grazing. Shallowness, susceptibility to erosion, and low fertility make these soils unsuitable for cultivation.

Profile of an Epping silt loam in native grass pasture, located 200 feet west and 400 feet north of the center of sec. 4, T. 41 N., R. 35 W.

A1—0 to 4 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) when moist; weak, coarse and medium, platy structure breaking to weak, fine, granular; soft when dry, friable when moist; many bits and fragments of siltstone; mildly alkaline; abrupt, smooth boundary.

C—4 to 7 inches, light-gray (10YR 7/2) silt loam, brown (10YR 5/3) when moist; weak, coarse, platy structure; calcareous; moderately alkaline; abrupt, smooth boundary.

C&R—7 to 24 inches, pinkish-gray (7.5YR 7/2) silt and soft siltstone, brown (7.5YR 5/2) when moist; bedded; calcareous; lime coats on horizontal breakage planes; moderately alkaline.

The A horizon ranges from 1 to 5 inches in thickness. It is dark colored, in places, and its texture ranges from silt loam to light silty clay loam. Some profiles have an AC horizon that is up to 10 inches thick and has weak subangular blocky structure. These soils are calcareous within 6 inches of the surface. The depth to bedded geologic material ranges from 6 to 22 inches. The siltstone is hard and becomes increasingly noncalcareous with depth in many places in the eastern part of the county, but it generally can be penetrated with an auger or spade in the western part.

Epping soils are more shallow, are calcareous nearer the surface, and lack the clayey subsoil of Huggins and Kadoka soils. They are more silty than Canyon soils, and they have a harder substratum than Colby soils.

Epping complex, 9 to 40 percent slopes (EhF).—Epping soils make up about 50 to 70 percent of this complex, Kadoka soils 15 to 35 percent, and other soils 15 percent. The areas are on ridges, escarpments, and steep valley side slopes (fig. 3). They range up to 500 acres in size and are mainly in the northern half of the county. A few outcrops of siltstone, up to 3 acres in size, are on the upper part of some slopes. Epping soils are on the upper part of the steeper slopes, and Kadoka soils are on the more gentle slopes. The surface layer of these soils typically is silt loam.

Included in the areas mapped are Colby, Goshen, Keith, and Ulysses soils. Goshen soils are on foot slopes and along

Figure 3.—**An area of Epping complex, 9 to 40 percent slopes.**

drainageways; Colby, Keith, and Ulysses soils are on rounded ridges and knolls, mainly on the east-facing and south-facing slopes. These inclusions generally are less than 10 acres in size.

All of this complex is in native grass and is used for grazing. In some places there are scattered pines and cedars, mostly on north-facing slopes. Gullies form easily along stock trails and wherever the grass cover is removed. Seeding and other mechanical measures are not feasible in most areas. The only practical ways to control erosion are maintenance of the grass cover and proper range use. (Epping in Shallow range site, capability unit VIIs–2, not placed in windbreak group; Kadoka in Silty range site, capability unit VIe–1, windbreak group 2)

Epping-Kadoka silt loams, 9 to 18 percent slopes (EkE).—Epping soils make up 40 to 70 percent of this complex, and Kadoka soils 30 to 60 percent. These soils are on ridges and side slopes along intermittent streams and draws. The areas are irregular in shape and range up to 500 acres in size. Epping soils are on ridgetops and the upper slopes. They have the profile described for the series. Kadoka soils, which are on the mid and lower slopes, ordinarily have a thinner surface layer and subsoil than is typical for the Kadoka series. The surface layer typically is silt loam.

Included in the areas mapped are small bodies of Colby, Goshen, Huggins, Keith, Ulysses, Wanblee, and Wortman soils. Goshen, Wortman, and Wanblee soils are on foot slopes and along drainageways. Huggins soils are on the wider ridgetops, and Colby, Keith, and Ulysses soils are on rounded ridges and east-facing and south-facing slopes. Inclusions make up less than 10 percent of any given area.

Nearly all of this complex is in native grass and is used for grazing. A few areas of Kadoka soils are used for native hay. Erosion is a hazard where the vegetation has been removed. Maintaining the grass cover helps to control erosion. Seeding and other mechanical measures are feasible. (Epping in Shallow range site, capability unit VIs–2, not placed in a windbreak group; Kadoka in Silty range site, capability unit VIe–1; windbreak group 2)

Epping-Rock outcrop complex (9 to 40 percent slopes) (Er).—Epping soils make up about 50 to 60 percent of this complex, Rock outcrop 15 to 25 percent, and Kadoka and other soils 25 percent. The areas are on escarpments and steep side slopes and on canyon walls along deeply entrenched drainageways, mainly in the northern part of the county. They are more broken and have more siltstone outcrops than areas of Epping complex, 9 to 40 percent slopes. They are irregular in shape and range up to 1,000 acres in size. Epping soils are on steep, grassy slopes, and Kadoka soils are on the more gentle slopes. The surface layer typically is silt loam. Rock outcrop, which consists of siltstone and soft siltstone, is closely intermingled with Epping soils on the upper part of the steep slopes and occurs also as almost vertical canyon walls. These outcrops are mostly less than 2 acres in size, but some range up to 30 acres.

Included in the areas mapped are bodies of Alluvial land and of Colby, Goshen, Keith, and Ulysses soils. Alluvial land is in narrow strips on the bottoms of ravines and canyons; Goshen soils are on foot slopes; and Colby, Keith, and Ulysses soils are on rounded ridges.

The Rock outcrop part of this complex is mostly bare; the rest is in native grass and is used for grazing. Sparse to moderate stands of pine and cedar on some of the north-facing slopes provide protection for livestock and game animals and are sources of fenceposts and firewood. Erosion is a hazard. Active gullies occur near the outcrops. Except in small areas of Kadoka soils, seeding and other mechanical measures are not feasible. Proper range use and the maintenance of a good grass cover are the only practical ways to control erosion. (Epping in Shallow range site, capability unit VIIs—2, not placed in a windbreak group; Rock outcrop in capability unit VIIIs–1, not placed in a range site or windbreak group)

Goshen Series

The Goshen series consists of deep, nearly level, friable, dark-colored, medium-textured soils. These soils formed in alluvium. They occur on foot slopes and in swales on uplands.

In a typical profile, the surface layer is about 16 inches thick. It is dark-gray silt loam of weak subangular blocky, prismatic, and granular structure. It is soft when dry and friable when moist.

The subsoil is about 29 inches thick. The upper 5 inches is dark-gray silt loam of weak prismatic and moderate subangular and angular blocky structure. It is slightly hard when dry and friable when moist. The lower 24 inches is grayish-brown silty clay loam of weak prismatic and strong blocky structure. It is very hard when dry and firm when moist.

The underlying material is calcareous, pale brown and very pale brown silt loam. It is structureless and is soft when dry and friable when moist.

Goshen soils are moderately well drained and have high fertility. Surface runoff is slow, permeability is moderate, and the water-holding capacity is high.

The native vegetation consists mainly of mid and tall grasses. Many areas are cultivated, and some are in native grass used for grazing and hay.

Profile of Goshen silt loam, 0 to 3 percent slopes, in native grass pasture, located 1,240 feet south and 1,300 feet west of the NE. corner of sec. 30, T. 40 N., R. 35 W.

A11—0 to 9 inches, dark-gray (10YR 4/1) silt loam, black (10YR 2/1) when moist; weak, medium and coarse, subangular blocky structure breaking to weak, me-

dium, granular; soft when dry, friable when moist; neutral; clear, smooth boundary.

A12—9 to 16 inches, dark-gray (10YR 4/1) silt loam, black (10YR 2/1) when moist; weak, medium, prismatic structure breaking to weak, medium, subangular blocky and weak, medium, granular; soft when dry, friable when moist; neutral; abrupt, smooth boundary.

B21t—16 to 21 inches, dark-gray (10YR 4/1) heavy silt loam, black (10YR 2/1) when moist; weak, medium, prismatic structure breaking to moderate subangular and angular blocky; slightly hard when dry, friable when moist; thin patchy clay films; many worm casts; neutral; abrupt, smooth boundary.

B22t—21 to 33 inches, grayish-brown (10YR 5/2) silty clay loam, very dark gray (10YR 3/1) when moist; weak, medium and coarse, prismatic structure breaking to strong, fine, blocky; very hard when dry, firm when moist; thin continuous clay films; many worm casts; mildly alkaline; clear, smooth boundary.

B23t—33 to 45 inches, grayish-brown (10YR 5/2) silty clay loam, very dark gray (10YR 3/1) when moist; weak, fine, prismatic structure breaking to strong, fine, blocky; very hard when dry, firm when moist; thin continuous clay films; many worm casts; mildly alkaline; gradual, smooth boundary.

C1—45 to 54 inches, pale-brown (10YR 6/3) silt loam, dark grayish brown (10YR 4/2) when moist; structureless; soft when dry, friable when moist; calcareous; moderately alkaline; gradual boundary.

C2—54 to 60 inches, very pale brown (10YR 7/3) silt loam, dark grayish brown (10YR 4/2) when moist; structureless; soft when dry, friable when moist; calcareous; moderately alkaline.

The A horizon ranges from 10 to 20 inches in thickness. The B horizon ranges from 15 to 36 inches in thickness and is dark colored in at least the upper part. The depth to lime ranges from 38 to 60 inches, and finely segregated lime masses occur in some places.

Goshen soils have a thicker and darker colored surface layer than Kadoka, Keith, Richfield, and Rosebud soils. They are less clayey than Hoven and Wortman soils.

Goshen silt loam, 0 to 3 percent slopes (GoA).—This soil is along upland drainageways in the central and southern parts of the county. The areas are long and narrow and are mostly less than 30 acres in size.

Included in mapping were small bodies of Kadoka, Keith, Richfield, Rosebud, Hoven, and Mosher soils. The areas of Hoven soils generally are less than 1 acre in size and occur where water is ponded. Mosher soils are nearby. Inclusions make up less than 10 percent of any given area.

This soil is used for crops, range, or hay, depending on the use made of the adjacent soils. Winter wheat is the main crop, but oats, barley, corn, sorghum, and alfalfa also are grown. The moisture supply is good except during prolonged dry periods. Grain crops tend to lodge in wet years. Management needs include maintenance of organic-matter content, fertility, and tilth. (Overflow range site, capability unit IIc–1, windbreak group 2)

Gravelly Land

Gravelly land (2 to 30 percent slopes) (Gr) consists of mixed gravelly soil material on upland ridges, terraces, and terrace fronts. Much of this land type is in the northern part of the county, but a few areas occur in all parts. Some areas are nearly level, but most have a slope range of up to 30 percent. The texture in the upper part ranges from sand to clay loam, and that in the lower part, which is light colored, from sand to clay. Gravel occurs within 20 inches of the surface. The gravelly material is several feet thick in some places, but in other places silt, clay, or shale occurs at a depth of less than 3 feet. Included in the areas mapped are small bodies of Altvan, Manter, Pierre, Samsil, Ulysses, and Valentine soils. These inclusions make up less than 30 percent of any given area.

All areas are in native grass and are used for grazing. Erosion is a hazard wherever vegetation is lacking. Proper range use is the best way to control erosion. Seeding and other mechanical measures are not feasible in most areas, because of the gravel or slope. (Shallow range site, capability unit VIIs–2, not placed in a windbreak group)

Haverson Series

This series consists of deep, nearly level, friable to firm, light-colored, calcareous, medium-textured and moderately fine textured soils (fig. 4). These soils formed in alluvium. They are on bottom lands along the White River and its main tributaries.

In a typical profile, the surface layer, about 1 inch thick, is gray loam of weak platy and granular structure. Below this layer is about 9 inches of calcareous, light-gray loam of weak platy and subangular blocky structure. This material is soft when dry and very friable when moist.

Figure 4.—**Profile of Haverson loam, low, 0 to 3 percent slopes.**

The underlying material is calcareous, light-gray silt loam and very fine sandy loam. It is structureless and is soft or slightly hard when dry and friable or very friable when moist. Very thin lenses of sand, loam, and clay loam occur in the upper part.

Haverson soils are moderately well drained to well drained. They are low in fertility and high in lime content. Surface runoff is slow, permeability ranges from moderately slow to moderately rapid, and the water-holding capacity is moderate to high. Areas of these soils on the lower flood plains are flooded in some years, but those on the higher ones are rarely flooded. In many areas the depth to the water table is 10 to 20 feet.

The native vegetation consists of tall, mid, and short grasses and scattered thickets of trees and shrubs. Many areas are in native grass and are used for grazing and hay. Some areas are in crops. Alfalfa is the main crop, but oats, barley, winter wheat, corn, and sorghum also are grown. Haverson soils respond well to irrigation.

Profile of a Haverson loam in native grass pasture, located 2,565 feet east and 1,300 feet south of the NW. corner of sec. 34, T. 44 N., R. 35 W.

A1—0 to 1 inch, gray (10YR 6/1) loam, very dark gray (10YR 3/1) when moist; weak, fine, platy structure breaking to weak, fine and coarse, granular; soft when dry, friable when moist; calcareous; moderately alkaline; abrupt, smooth boundary.

AC—1 to 10 inches, light-gray (10YR 7/2) loam, grayish brown (10YR 5/2) when moist; weak, coarse, platy structure breaking to weak, medium, subangular blocky; soft when dry, very friable when moist; worm casts common; calcareous; moderately alkaline; clear, smooth boundary.

C1—10 to 31 inches, light-gray (10YR 7/2) silt loam, pale brown (10YR 6/3) when moist; stratified with very thin lenses of sand, loam, and clay loam; structureless; slightly hard when dry, friable when moist; calcareous; moderately alkaline; gradual boundary.

C2—31 to 60 inches, light-gray (10YR 7/2) stratified silt loam and very fine sandy loam; grayish brown (10YR 5/2) when moist; structureless; soft when dry, very friable when moist; calcareous; moderately alkaline.

The A horizon ranges from 1 to 6 inches in thickness and from very fine sandy loam to silty clay loam in texture. The AC horizon ranges up to 10 inches in thickness but is absent in places. The C horizon ordinarily becomes more sandy with depth.

Haverson soils are lighter colored than Goshen soils and lack a distinct subsoil. Haverson soils formed in material of less uniform texture than Colby soils, which are somewhat excessively drained.

Haverson loam, high, 0 to 3 percent slopes (HhA).—This soil is on high bottoms along the White River and is seldom flooded. The slope is mostly less than 1 percent. The areas range up to 300 acres in size. This soil has a profile like the one described for the series, except that in some areas the underlying material consists of very fine sandy loam and very fine sand. Included in the areas mapped are small bodies of Haverson silty clay loam, 0 to 3 percent slopes, and Kyle clay, alkali, 0 to 3 percent slopes. Inclusions make up less than 10 percent of any given area.

Most areas of this soil are in native grass and are used for grazing and hay. Alfalfa is the main crop. This soil is somewhat droughty and is subject to soil blowing. Also, it is low in organic-matter content and low in natural fertility. Moisture can be conserved and soil blowing controlled by maintaining the organic-matter content, increasing fertility, and keeping an adequate cover of crop residue. (Silty range site, capability unit IIIc–2, windbreak group 2)

Haverson loam, low, 0 to 3 percent slopes (HlA).—This soil has the profile described for the series. It occurs on bottom lands along the White River and its tributaries and is flooded occasionally. The areas range up to 300 acres in size. Included in the areas mapped are small bodies of Haverson loam, high, 0 to 3 percent slopes, and Haverson silty clay loam, 0 to 3 percent slopes. Also included are mixed soil materials in areas nearest the river and along old overflow channels. Inclusions make up less than 10 percent of any given area.

Many areas of this soil are in native grass and are used for grazing and hay. Scattered cottonwood trees and shrub thickets protect livestock in winter. Some areas are in crops. Alfalfa is the main crop, but oats, barley, corn, and sorghum also are grown. Floods occasionally damage fences and result in the accumulation of sediment and debris, but the floods are beneficial in most places because they provide additional moisture. Fields used for native grass and alfalfa are less affected by flood damage than fields used for annual crops. Alfalfa does well, but annual crops are affected by the low organic-matter content, low fertility, and periodic dry periods. Management needs include the conservation of moisture and improvement of fertility. (Overflow range site, capability unit IIIw–1, windbreak group 2)

Haverson silty clay loam, 0 to 3 percent slopes (HoA).—This soil is high in lime content. It is on bottom lands along the White River. The slope is mostly less than 1 percent. The areas range up to 150 acres in size.

This soil is stratified. The surface layer ranges from very fine sandy loam to silty clay, but the average texture is silty clay loam to a depth of 20 inches. The underlying material consists of alternating layers of sand, loam, and silty clay. In places streaks and spots of salts occur in the silty clay below a depth of 20 inches. Included in the areas mapped are small bodies of Haverson loam, low, 0 to 3 percent slopes, and Kyle clay, alkali, 0 to 3 percent slopes. The Haverson soil generally is close to the main stream channel, and the Kyle soil is on the outer edges of the stream valley. Inclusions make up less than 10 percent of any given area.

Most areas are in native grass and are used for grazing and hay. Scattered thickets of trees and shrubs protect livestock in winter. Some areas are in cultivation; alfalfa is the main crop. Floods, which are a problem in some years, damage fences and result in the accumulation of sediment and debris. These floods are beneficial in most areas, however, because they provide additional moisture. Alfalfa grows well, but annual crops are affected by a moisture shortage and by low fertility. Management needs include the conservation of moisture and an improvement in organic-matter content and fertility. (Overflow range site, capability unit IIIw–1, windbreak group 2)

Hisle Series

The Hisle series consists of shallow to moderately deep, nearly level to gently sloping, firm, light-colored, fine-textured soils that have a claypan. These soils formed in clayey materials of variable thickness over clay shale.

They have plane and concave slopes and are in upland basins and valleys in the northern part of the county.

In a typical profile, the surface layer is about 2 inches thick. It is light yellowish-brown clay of weak platy and granular structure. It is slightly hard when dry and friable when moist.

The subsoil, about 7 inches thick, is calcareous, light yellowish-brown clay. The upper part has moderate columnar and strong blocky structure. The lower part has blocky structure. This layer is very hard when dry and firm when moist.

The underlying material is light yellowish-brown, bedded clay shale. It is calcareous in the upper part.

Hisle soils are moderately well drained to well drained, are low in fertility, and are in poor tilth. Surface runoff is slow ordinarily but is rapid during intense rainstorms. Permeability is very slow. Water ponds in depressions.

The native vegetation consists of sparse stands of mid and short grasses. Hisle soils are not suitable for cultivation and are used for grazing. Some of the ponded depressions are bare or almost bare.

Profile of Hisle clay in native grass pasture, located 100 feet south of a dam and 500 feet west of a fence in the NE¼ of sec. 9, T. 43 N., R. 36 W.

A2—0 to 2 inches, light yellowish-brown (2.5Y 6/4) clay, light olive brown (2.5Y 5/4) when moist; weak, fine, platy structure breaking to weak, fine, granular; slightly hard when dry, friable when moist; neutral; abrupt, smooth boundary.

B2t—2 to 4 inches, light yellowish-brown (2.5Y 6/4) clay, light olive brown (2.5Y 5/4) when moist; moderate, medium, columnar structure breaking to strong, medium, blocky; very hard when dry, firm when moist; calcareous; strongly alkaline; abrupt, smooth boundary.

B3—4 to 9 inches, light yellowish-brown (2.5Y 6/4) clay, light olive brown (2.5Y 5/4) when moist; weak, coarse, blocky structure; very hard when dry, firm when moist; calcareous; strongly alkaline; abrupt boundary.

R—9 to 60 inches, light yellowish-brown (2.5Y 6/4) clay shale; bedded; calcareous in upper part.

The A horizon ranges from 1 to 3 inches in thickness, from loam to clay in texture, and from light gray to light yellowish brown in color. The B horizon ranges from 2 to 14 inches in thickness and has weak to strong columnar structure in the upper part. Visible salts, mostly gypsum, are in the lower part and extend into the upper part of the shale in places. The soil color varies according to the depth to shale, which ranges from 6 to 40 inches. In some places fragments of iron and manganese and rounded quartz pebbles are scattered over the surface and through the soil.

Hisle soils are more clayey than Wanblee soils. They are more shallow to shale than Swanboy soils, which lack columnar structure.

Hisle clay (0 to 9 percent slopes) (Hs).—This soil occurs on plane to concave side slopes in the northern part of the county. It has a claypan. The areas range from 20 to 100 acres in size. Many are nearly level. In some of these, the depth to shale is more than 40 inches.

Included in the areas mapped are small bodies of Kyle, Pierre, Samsil, and Swanboy soils. The Pierre and Samsil soils are on the convex slopes, and the Kyle and Swanboy soils are in the more nearly level areas. These inclusions are irregular in their occurrence and usually make up less than 20 percent of any given area.

All of this soil is in native grass and is used for grazing. It is not suitable for cultivation. Management needs include the maintenance of native grass. Pitting and interseeding help to improve the stand. (Thin Claypan range site, capability unit VIs–1, not placed in a windbreak group)

Hoven Series

This series consists of deep, firm, dark-colored soils that have a claypan. These soils formed in local alluvium washed down from the adjacent slopes. They are in closed depressions on uplands.

In a typical profile, the surface layer, about 2 inches thick, is gray silt loam of platy or granular structure. It is slightly hard when dry and friable when moist.

The subsoil is about 34 inches thick. It is gray silty clay and is very hard or extremely hard when dry and very firm when moist. It has moderate columnar structure in the upper part and strong to moderate blocky structure in the lower part. Spots and streaks of soft lime and other salts occur in the lower part.

The underlying material is calcareous, gray silty clay. It is structureless and very hard when dry and very firm when moist. There are a few spots and streaks of soft lime and other salts.

Hoven soils are somewhat poorly drained to poorly drained and have moderate fertility. Runoff is ponded, and permeability is very slow. The use of these soils for crops is limited by wetness in spring. Crops drown in wet years.

The native vegetation consists mostly of mid grasses, but there are short grasses on the outer edges of some areas and small sedges in the wetter areas. Many areas are in native grass and are used for grazing and hay. Some of the smaller areas are in cultivation.

Profile of Hoven silt loam in native grass, located 2,040 feet west and 800 feet south of the NE. corner of sec. 29, T. 43 N., R. 37 W.

A2—0 to 2 inches, gray (10YR 6/1) silt loam, very dark gray (10YR 3/1) when moist; moderate, fine, platy structure breaking to weak, fine, granular; slightly hard when dry, friable when moist; neutral; abrupt, smooth boundary.

B21t—2 to 3 inches, gray (10YR 5/1) silty clay, very dark gray (10YR 3/1) when moist; moderate, medium and fine, columnar structure breaking to strong, medium and fine, blocky; very hard when dry, very firm when moist; continuous clay films; mildly alkaline; abrupt, smooth boundary.

B22t—3 to 10 inches, gray (10YR 5/1) silty clay, black (10YR 2/1) when moist; moderate, coarse, subangular blocky structure breaking to strong, medium and fine, blocky; extremely hard when dry, very firm when moist; continuous clay films; mildly alkaline; clear, smooth boundary.

B23t—10 to 17 inches, gray (10YR 6/1) silty clay, very dark gray (10YR 3/1) when moist; moderate, coarse, subangular blocky structure breaking to strong, fine, blocky; extremely hard when dry, very firm when moist; patchy clay films; mildly alkaline; abrupt, smooth boundary.

B3casa—17 to 36 inches, gray (10YR 6/1) silty clay, very dark gray (10YR 3/1) when moist; moderate, coarse, subangular blocky structure breaking to strong, fine, blocky; extremely hard when dry, very firm when moist; patchy clay films; calcareous; common, medium, distinct, soft lime segregations and salt crystals; strongly alkaline; clear, smooth boundary.

C—36 to 60 inches, gray (10YR 5/1) silty clay, very dark gray (10YR 3/1) when moist; structureless; very

hard when dry, very firm when moist; calcareous; few, fine and medium, soft lime segregations and salt crystals; moderately alkaline.

The A horizon ranges from 1 to 6 inches in thickness. Where this layer is thickest, the upper part is dark gray to dark grayish brown. The B horizon ranges from 10 to 40 inches in thickness and has moderate to strong blocky structure. The depth to lime ranges from 7 to 30 inches. The C horizon is variable and is as coarse textured as sandy loam in places.

Hoven soils are darker colored and grayer than Hisle soils, which have a shale substratum. They have a thinner surface layer than Mosher and Wortman soils.

Hoven silt loam (0 to 1 percent slopes) (Hv).—This soil is in closed upland depressions in almost all parts of the county. The areas are oval to circular in shape and are mostly less than 10 acres in size. Included in the areas mapped are small bodies of Goshen, Mosher, Richfield, and Wortman soils. These inclusions are on the outer edges of the depressions and make up less than 10 percent of any given area.

Some of the smaller depressions are in cultivation; winter wheat is the main crop. Most areas are in native grass and are used for grazing and hay. Runoff from the adjacent slopes keeps this soil wet, and in some years ponding affects crops and prevents tillage. Treatment of the adjacent soils helps to divert runoff. Grazing should be avoided when this soil is wet. (Closed Depression range site, capability unit VIs–1, not placed in a windbreak group)

Huggins Series

This series consists of shallow to moderately deep, level to sloping, friable to firm, dark-colored soils over siltstone. These soils are on uplands and are mostly in the eastern part of the county.

In a typical profile, the surface layer is about 7 inches thick. It is grayish-brown silt loam. The upper 3 inches has weak platy and granular structure and is soft when dry and friable when moist. The lower 4 inches has moderate subangular blocky and granular structure and is slightly hard when dry and friable when moist.

The subsoil is about 18 inches thick. The upper part is dark grayish-brown clay of weak prismatic and strong blocky structure. It is very hard when dry and firm when moist. The lower part is very pale brown silty clay loam of weak prismatic and moderate subangular blocky structure. It is hard when dry and friable when moist.

The underlying material is pinkish-gray siltstone. It is calcareous in the upper part.

Huggins soils are well drained and have moderate fertility. Surface runoff is medium, and permeability is moderately slow. The water-holding capacity is high, but moisture penetrates the underlying siltstone very slowly. The surface layer is thick enough to be worked easily. The siltstone limits the thickness of the root zone and affects the choice of crops.

The native vegetation consists of mid and short grasses. A few areas are in cultivation; wheat, oats, and barley are the main crops.

Profile of Huggins silt loam, 0 to 3 percent slopes, in native grass pasture, located 2,340 feet west and 75 feet north of the SE. corner of sec. 33, T. 42 N., R. 35 W.

A11—0 to 3 inches, grayish-brown (10YR 5/2) silt loam, very dark brown (10YR 2/2) when moist; weak, fine, platy structure breaking to weak, fine, granular; soft when dry, friable when moist; neutral; abrupt, smooth boundary.

A12—3 to 7 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, subangular blocky structure breaking to moderate, coarse, granular; slightly hard when dry, friable when moist; neutral; abrupt, smooth boundary.

B2t—7 to 15 inches, dark grayish-brown (10YR 4/2) clay, dark brown (10YR 3/3) when moist; weak, medium, prismatic structure breaking to strong, fine, blocky; very hard when dry, firm when moist; moderately thick continuous clay films on all ped faces; few fine bits of siltstone; mildly alkaline; abrupt, wavy boundary.

B3—15 to 25 inches, very pale brown (10YR 7/3) silty clay loam, yellowish brown (10YR 5/4) when moist; weak, coarse, prismatic structure breaking to moderate, medium, subangular blocky; hard when dry, friable when moist; thin very patchy clay films; many fine bits of siltstone; mildly alkaline; abrupt, wavy boundary.

R—25 to 60 inches, pinkish-gray (7.5YR 7/2) siltstone, pinkish gray (7.5YR 6/2) when moist; bedded; calcareous in upper part; moderately alkaline.

The A horizon ranges from 4 to 9 inches in thickness. The B horizon ranges from 8 to 22 inches in thickness. This layer includes clay, silty clay, and silty clay loam textures; the clay content is 35 percent or more. Below the B horizon, in some places, there is a transition layer consisting of a mixture of soft siltstone and hard siltstone. The depth to bedded siltstone ranges from 16 to 32 inches. In places the siltstone in the upper part is calcareous only between bedding planes. It generally becomes noncalcareous as the depth increases.

Huggins soils have a more clayey and more strongly structured subsoil than Kadoka soils. They are deeper to siltstone than Epping soils, which lack a distinct clayey subsoil.

Huggins silt loam, 0 to 3 percent slopes (HwA).—This soil is on uplands in the central and eastern parts of the county. The areas are irregular in shape and ordinarily less than 60 acres in size. In some places the surface layer and subsoil are thinner than is typical for the series, and the average depth to hard siltstone is about 20 inches.

Included in the areas mapped are small bodies of Epping, Kadoka, Richfield, and Wortman soils. Epping soils are on slight rises, and Wortman soils are in slight depressions. Kadoka soils occur irregularly in places where the siltstone is softer than usual and weathered to a greater depth. Richfield soils occur in concave spots where the siltstone is below a depth of 40 inches. Inclusions make up less than 15 percent of any given area.

Many areas of this soil are in native grass and are used for grazing, and some are cultivated, mainly to wheat, oats, and barley. Some areas that were once cultivated have been seeded to tame grasses. The main limitation is a shallow root zone. Crops are affected in years of low rainfall. Management needs include the conservation of moisture, maintenance of the organic-matter content, and preservation of structure. (Clayey range site, capability unit IIIs–1, windbreak group 2)

Kadoka Series

The Kadoka series consists of moderately deep, nearly level to moderately steep, friable, dark-colored soils. These soils formed in material weathered from bedded silt and siltstone. They are on uplands, mainly in the west-central and east-central parts of the county.

In a typical profile, the surface layer is about 4 inches thick. It is dark grayish-brown silt loam of weak subangular blocky and moderate granular structure. It is soft when dry and friable when moist.

The subsoil is about 18 inches thick. The upper part is dark grayish-brown silty clay loam of weak prismatic and moderate subangular blocky structure. It is slightly hard when dry and friable when moist. The middle part is brown silty clay loam of weak prismatic and moderate blocky structure. It is hard when dry and firm when moist. The lower part is pale-brown silt loam of weak prismatic and subangular blocky structure. It is slightly hard when dry, is friable when moist, and contains a few bits and fragments of siltstone.

The underlying material is calcareous, pinkish-white silt loam that contains many fragments of siltstone. The silt loam is structureless and is soft when dry and friable when moist. It is underlain by light-brown, bedded siltstone and silt at a depth of about 34 inches.

Kadoka soils are well drained, have moderate fertility, and are easy to work. Surface runoff is medium, permeability is moderate, and the water-holding capacity is moderate.

The native vegetation consists of mid and short grasses, many areas of which are used for grazing or hay. Some of the more gentle slopes are cultivated. Winter wheat is the main crop, but oats, barley, corn, sorghum, and alfalfa also are grown.

Profile of Kadoka silt loam, 3 to 5 percent slopes, in native grass pasture, located 0.4 mile east and 150 feet south of the NW. corner of sec. 22, T. 41 N., R. 35 W.

A1—0 to 4 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) when moist; weak, medium, subangular blocky structure breaking to moderate, fine, granular; soft when dry, friable when moist; neutral; clear, wavy boundary.

B21t—4 to 8 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; weak, fine and medium, prismatic structure breaking to moderate, fine and medium, subangular blocky; slightly hard when dry, friable when moist; thin very patchy clay films; neutral; clear, wavy boundary.

B22t—8 to 14 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) when moist; weak, medium, prismatic structure breaking to moderate, medium and fine, blocky; hard when dry, firm when moist; thin patchy clay films; mildly alkaline; clear, wavy boundary.

B3—14 to 22 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; weak, medium and coarse, prismatic structure breaking to weak, medium, subangular blocky; slightly hard when dry, friable when moist; few fine bits of siltstone; moderately alkaline; abrupt, irregular boundary.

Cca&R—22 to 34 inches, pinkish-white (7.5YR 8/2) silt loam and siltstone, pinkish gray (7.5YR 6/2) when moist; bedded; soft when dry, friable when moist; siltstone fragments up to 1 inch in diameter make up 30 percent of mass; calcareous, but matrix of siltstone is noncalcareous; moderately alkaline; gradual, irregular boundary.

R—34 to 45 inches, light-brown (7.5YR 6/4) siltstone and silt, brown (7.5YR 5/4) when moist; bedded; siltstone is lime coated, but matrix is noncalcareous; strongly alkaline.

The A horizon ranges from 3 to 8 inches in thickness. The texture ranges from loam to silty clay loam but commonly is silt loam. The B horizon ranges from 12 to 26 inches in thickness, has weak to moderate structure, and includes heavy silt loam and silty clay loam textures. The soils are calcareous either in the lower part of the B horizon or in the C horizon. The depth to lime ranges from 12 to 28 inches. Bedded silt and siltstone occur at a depth of 20 to 40 inches and range from very pale brown to pinkish white in color. This material generally is unconsolidated in the western part of the county and is cemented and hard in the eastern part.

Kadoka soils have a less clayey and less well developed subsoil than Huggins soils and, on the average, are deeper to siltstone. They are deeper to siltstone than Epping soils, which lack a distinct subsoil. Kadoka soils are more silty than Rosebud soils. They contain bits of siltstone and are underlain by harder material than Keith soils.

Kadoka silt loam, 0 to 3 percent slopes (KaA).—This soil is on upland divides and is commonly in areas less than 40 acres in size. In places the surface layer and subsoil are thicker than is typical for the series. Surface runoff is slower.

Included in the areas mapped are small bodies of Goshen, Keith, Richfield, and Wortman soils. The areas of Goshen and Wortman soils are along slightly depressed drainageways and are seldom more than 50 feet wide. Keith and Richfield soils occur irregularly. Inclusions make up less than 10 percent of any given area.

About half of this soil is in native grass and is used for grazing and hay. Much of the cropland is in the eastern part of the county. Winter wheat is the main crop, but oats, barley, corn, sorghum, and alfalfa also are grown. Moisture conservation is the main management problem. (Silty range site, capability unit IIIc–1, windbreak group 2)

Kadoka silt loam, 3 to 5 percent slopes (KaB).—This soil is on uplands in the west-central and east-central parts of the county. The areas range up to 150 acres in size. The profile is the one described for the series.

Included in the areas mapped are small bodies of Epping, Goshen, Huggins, Keith, and Richfield soils. Epping and Huggins soils are on the crests of slopes, and Goshen soils are in swales. Keith and Richfield soils are on some east-facing and south-facing slopes. Inclusions seldom exceed 15 percent of any given area.

This soil is used both as range and as cropland. The cultivated areas are mostly in the east-central part of the county. Winter wheat is the main crop, but oats, barley, corn, sorghum, and alfalfa also are grown. The main management problem is the control of water erosion. Secondary problems are conservation of moisture; control of soil blowing; and maintenance of organic-matter content, fertility, and tilth. Proper range use provides adequate control of erosion for areas still in native grass. (Silty range site, capability unit IIIe–1, windbreak group 2)

Kadoka silt loam, 5 to 9 percent slopes (KaC).—This soil is on uplands in the east-central and west-central parts of the county. It occurs in areas up to 200 acres in size. In some places the subsoil is thinner than is typical for the series and averages only about 20 inches to bedded silt and siltstone.

Included in the areas mapped are small bodies of Epping, Goshen, Huggins, Keith, Manter, Tuthill, Ulysses, and Wortman soils. Epping and Huggins soils are on ridgetops and the upper part of slopes. Keith and Ulysses soils are in patches on the longer, usually east-facing and south-facing slopes. Manter and Tuthill soils occur in areas where this Kadoka soil adjoins larger areas of

sandy soils. Goshen and Wortman soils are on foot slopes and along upland drainageways. Inclusions are irregular in occurrence and seldom make up more than 20 percent of a given area.

Most areas are in native grass and are used for grazing and hay. Some areas, mostly in the eastern part of the county, are cultivated. Winter wheat is the main crop, but feed grain and alfalfa also are grown. Some areas that once were cultivated have been seeded to tame grasses. The control of water erosion is the main management problem. Management needs include conservation of moisture, control of soil blowing, and maintenance of fertility and tilth. Proper range use provides adequate control of erosion for areas still in native grass. (Silty range site, capability unit IVe–2, windbreak group 2)

Kadoka-Epping silt loams, 3 to 9 percent slopes (KbC).—Kadoka soils and Epping soils each make up 40 to 60 percent of this complex. The areas are on uplands in the west-central and east-central parts of the county. They range up to 300 acres in size. The slope range is mostly 5 to 9 percent. Epping soils are on the ridgetops and upper side slopes. Kadoka soils are on the mid and lower side slopes and on the broader drainage divides. The combined thickness of the surface layer and subsoil is less than is typical for the Kadoka series; bedded geologic material occurs in many places at a depth of 20 to 24 inches.

Included in the areas mapped are small bodies of Colby, Goshen, Huggins, Keith, Ulysses, Wanblee, and Wortman soils. Goshen, Wanblee, and Wortman soils are on foot slopes and in swales. Huggins soils are in areas underlain by the harder layers of siltstone. Colby, Keith, and Ulysses soils occur in patches. Inclusions occur irregularly and make up less than 10 percent of any given area.

Most areas of this complex are in native grass and are used for grazing and hay. Only a few areas are in crops. Control of water erosion and conservation of moisture are the main management problems. Proper range use meets these problems in areas still in grass. Intensive management is needed in areas used for crops. (Kadoka in Silty range site, capability unit, IIIe–1, windbreak group 2; Epping in Shallow range site, capability unit VIs–2, not placed in a windbreak group)

Kadoka-Huggins complex, 3 to 9 percent slopes (KdC).—Kadoka soils make up 50 to 70 percent of this complex, and Huggins soils 30 to 50 percent. The areas are on uplands in the central and east-central parts of the county and range up to 300 acres in size. These two soils are closely associated; their occurrence depends on the hardness of the underlying siltstone. Kadoka soils have a slightly thinner subsoil than is typical for the series, and the depth to bedded silt and siltstone ranges from 20 to 30 inches. The surface layer is dominantly silt loam but includes loam and silty clay loam. The slope range is mostly 5 to 9 percent. Most areas of Huggins soils have a slope range of 3 to 5 percent.

Included in the areas mapped are small bodies of Epping, Wanblee, and Wortman soils. Epping soils are on the upper part of slopes, on ridgetops, and on the shoulders of drainageways. Wanblee and Wortman soils are on foot slopes. Inclusions make up less than 15 percent of any given area.

Most areas of this complex are in native grass and are used for grazing and hay. A few areas are cultivated, mainly to winter wheat, oats, and barley. Control of water erosion and soil blowing and conservation of moisture are the main management problems. Proper range use meets these problems in areas still in native grass. Intensive management is needed in areas used for crops. (Kadoka in Silty range site, capability unit IIIe–1, windbreak group 2; Huggins in Clayey range site, capability unit IVe–5, woodland group 2)

Keith Series

The Keith series consists of deep, nearly level to rolling, friable, dark-colored soils. These soils formed in silty loess and occur on uplands through all parts of the county.

In a typical profile, the surface layer is about 6 inches thick. It is dark-gray to grayish-brown silt loam of weak subangular blocky and granular structure. It is soft to slightly hard when dry and friable when moist.

The subsoil is silty clay loam about 13 inches thick. It is brown in the upper part and pale brown in the lower part. It has weak prismatic and moderate blocky or subangular blocky structure and is hard when dry and firm when moist.

The underlying material is calcareous, light-gray silt loam. It has weak subangular blocky structure in the upper part and is structureless in the lower part. It is slightly hard or soft when dry and friable when moist. There are many fine streaks and threads of soft lime. This material changes abruptly, at a depth of about 55 inches, to white bedded silt that contains many fine bits of siltstone.

Keith soils are well drained, have high fertility, and are easy to work. Surface runoff is medium, permeability is moderate, and the water-holding capacity is high.

The native vegetation consists of mid and short grasses. Many areas in the central and eastern parts of the county are cultivated. Winter wheat is the main crop, but oats, barley, corn, sorghum, and alfalfa also are grown. Some of the more rolling areas are in native grass and are used for grazing and hay.

Profile of Keith silt loam, 3 to 5 percent slopes, in native grass pasture, located 1,340 feet south and 700 feet east of the NW. corner of sec. 12, T. 41 N., R. 37 W.

A11—0 to 4 inches, dark-gray (10YR 4/1) silt loam, very dark brown (10YR 2/2) when moist; weak, medium, subangular blocky structure breaking to moderate, fine, granular; soft when dry, friable when moist; neutral; abrupt, smooth boundary.

A12—4 to 6 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, subangular blocky structure breaking to moderate, fine, granular; slightly hard when dry, friable when moist; neutral; abrupt, smooth boundary.

B21t—6 to 14 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) when moist; ped coats darker colored; weak, fine, prismatic structure breaking to moderate, medium, blocky; hard when dry, firm when moist; thin continuous clay films; neutral; clear, smooth boundary.

B22t—14 to 19 inches, pale-brown (10YR 6/3) silty clay loam, dark grayish brown (10YR 4/2) when moist; ped coats darker colored; weak, medium, prismatic structure breaking to moderate, coarse, subangular blocky; hard when dry, firm when moist; thin

patchy clay films; many worm casts; mildly alkaline; abrupt, smooth boundary.

C1ca—19 to 40 inches, light-gray (10YR 7/2) silt loam, brown (10YR 5/3) when moist; weak, coarse, subangular blocky structure; slightly hard when dry, friable when moist; many worm casts; calcareous; many, fine, soft lime segregations; moderately alkaline; clear, smooth boundary.

C2—40 to 55 inches, light-gray (10YR 7/2) silt loam, brown (10YR 5/3) when moist; structureless; soft when dry, friable when moist; calcareous; few, fine, soft lime segregations; moderately alkaline; abrupt, smooth boundary.

IIC3—55 to 61 inches, white (10YR 8/2) silt with many fine bits of siltstone, pale brown (10YR 6/3) when moist; bedded; calcareous; many soft lime segregations; strongly alkaline.

The A horizon ranges from 3 to 11 inches in thickness. Silt loam is the dominant texture, but loam and very fine sandy loam are present in places. The thickness of the B horizon ranges from 12 to 40 inches. The soils are calcareous in either the lower part of the B horizon or in the C horizon. The depth to lime ranges from 15 to 34 inches. The IIC layer of loess extends to a depth of 5 feet or more in most places. Locally, the loess changes abruptly at a depth of about 40 inches to weathered geologic material containing fine bits of sandstone or siltstone.

Keith soils are deeper to lime segregations and have a more distinct subsoil than Ulysses soils. The subsoil is less clayey than that of Richfield soils. Keith soils are more silty than Rosebud soils. They are underlain by softer material than Kadoka and Rosebud soils. Keith soils are not dark colored to so great a depth as Goshen soils.

Keith silt loam, 0 to 3 percent slopes (KeA).—This soil is on upland divides in the central and eastern parts of the county and on tablelands and high terraces in the northern part (fig. 5). The areas range up to 400 acres in size. In places the surface layer and subsoil are thicker than is typical for the series, and the depth to lime is about 30 inches. Some areas have a surface layer of loam or very fine sandy loam.

Included in the areas mapped are small bodies of Goshen, Hoven, Richfield, and Ulysses soils. Goshen, Richfield, and Hoven soils are in slight depressions. Ulysses soils are on the outer edges of high terraces in the northern part of the county. Inclusions generally make up less than 15 percent of a given area.

This soil is suitable for use both as cropland and as range. Many areas are in cultivation. Winter wheat is the main crop, but oats, barley, corn, sorghum, and alfalfa also are grown. Soil blowing is a hazard in clean-fallowed fields. Management needs include conservation of moisture and maintenance of fertility and good tilth. Proper range use meets these needs in areas still in native grass. (Silty range site, capability unit IIc–1, windbreak group 2)

Figure 5.—**An area of Keith silt loam, 0 to 3 percent slopes.**

Keith silt loam, 3 to 5 percent slopes (KeB).—This soil is on uplands and high terraces in all parts of the county. Many of the slopes are more than 300 feet long. The areas range up to 500 acres in size. The profile is the one described for the series.

Included in the areas mapped are small bodies of Goshen, Kadoka, Oglala, Richfield, Rosebud, and Ulysses soils. Goshen and Richfield soils are on foot slopes and in swales. Kadoka, Oglala, and Rosebud soils occur where the loess thins out. Ulysses soils are on the upper part of slopes. Inclusions ordinarily make up less than 15 percent of a given area, but Ulysses soils make up more than 15 percent of areas on the high terraces in the northern part of the county.

Many areas of this Keith soil are cultivated and are used for winter wheat, oats, barley, corn, sorghum, and alfalfa. Most areas in the western part of the county are in native grass and are used for grazing and hay. Management needs include control of erosion; conservation of moisture; and maintenance of organic-matter content, fertility, and tilth. Proper range use provides adequate control of erosion for areas still in native grass. (Silty range site, capability unit IIe–1, windbreak group 2)

Keith-Colby silt loams, 9 to 12 percent slopes (KhD).—Keith soils make up 40 to 80 percent of this complex, and Colby soils 20 to 40 percent. These soils are on rolling uplands, largely in the western part of the county. Keith soils are on the mid and lower side slopes. The surface layer is only 4 inches thick in some areas. Colby soils are on the tops of well-rounded ridges and knolls and on the upper part of slopes.

Included in the areas mapped are small bodies of Ulysses soils, which are on the upper part of the side slopes. Also included are areas of Canyon, Epping, Goshen, Kadoka, Oglala, and Rosebud soils.

This complex is suitable for use both as cropland and as range. Most areas are in native grass and are used for grazing and hay. A few areas are cropped, mainly to winter wheat and alfalfa. Erosion control is the chief management problem. Intensive measures are needed in areas used for crops. Proper range use provides adequate erosion control for areas still in native grass. (Keith in Silty range site, capability unit IVe–1, windbreak group 2; Colby in Thin Upland range site, capability unit IVe–1, windbreak group 2)

Keith-Colby silt loams, 12 to 25 percent slopes (KhE).—Keith soils make up about 40 to 50 percent of this complex, Colby soils 35 to 45 percent, and other soils 15 percent. These soils are on uplands and are mostly in the western part of the county. Keith soils are on the mid and lower side slopes. The surface layer is only about 4 inches thick, and the depth to calcareous material is between 15 and 20 inches. Colby soils are on ridgetops and the upper part of side slopes.

Included in the areas mapped on the upper and mid slopes are areas of Ulysses soils. These inclusions make up

more than 15 percent of any given area. Also included are bodies up to 10 acres in size of Canyon, Epping, Kadoka, Oglala, and Rosebud soils.

Almost all of this complex is in native grass and is used for grazing. A few areas that were once cultivated have been seeded to either tame or native grasses. Erosion is the main management problem. Because of the steep slopes, erosion is too difficult to control for the soils to be used for crops. Proper range use provides adequate control of erosion for areas still in native grass. Range seeding and contour furrowing help to retard runoff and to improve range condition. (Keith in Silty range site, capability unit VIe-1, windbreak group 2; Colby in Thin Upland range site, capability unit VIe-1, windbreak group 2)

Keith-Rosebud silt loams, 3 to 5 percent slopes (KrB).—Keith and Rosebud soils each make up 40 to 60 percent of this complex. These soils are on drainage divides and ridges across the southern half of the county. The areas are mostly less than 80 acres in size. Keith soils are dominant in the southwestern part of the county, and Rosebud soils are dominant in the southeastern part. Generally, Keith soils are on the longer and smoother slopes, which usually face south and east, and Rosebud soils are on the somewhat shorter slopes, which face north and west. The pattern of occurrence is erratic, however, and in places the two soils are closely intermingled.

Included in the areas mapped are small bodies of Canyon, Goshen, Richfield, and Ulysses soils. Ulysses soils are on the crests of slopes. Canyon soils are on the crests of slopes and on the sharp shoulders of drainageways. Richfield soils are on the lower part of the slopes, and Goshen soils are along upland drainageways. Inclusions make up less than 10 percent of any given area.

Many areas of this complex are cultivated. Winter wheat is the main crop, but oats, barley, corn, sorghum, and alfalfa also are grown. Management needs include control of erosion; conservation of moisture; and the maintenance of organic-matter content, fertility, and tilth. Proper range use provides adequate control of erosion for areas still in native grass. (Silty range site, capability unit IIe-1, windbreak group 2)

Keith-Rosebud-Canyon complex, 5 to 9 percent slopes (KsC).—Keith soils make up 50 to 60 percent of this complex, Rosebud soils 20 to 40 percent, and Canyon soils 10 to 20 percent. These soils are on uplands in the central and southern parts of the county. The areas range up to 600 acres in size. Keith soils are on the longer side slopes, which usually face east and south. They have a profile similar to the one described for the series, but the surface layer is loam in some places. Rosebud soils are on the upper side slopes. In places they have a silt loam surface layer, and the upper part of the subsoil is silty clay loam. Generally, there are fragments and bits of sandstone in the lower subsoil and the underlying material. Canyon soils are on the crests of slopes. In cultivated areas they generally are eroded and so mixed with the underlying material that their occurrence is easily observed by their light color.

Included in the areas mapped are small bodies of Goshen, Oglala, and Richfield soils. Goshen soils are along drainageways. Oglala soils are on mid and lower slopes, and Richfield soils are on the lower end of long slopes. Inclusions make up less than 10 percent of any given area.

Many areas of this complex are in native grass and are used for grazing and hay. Some are cultivated, mainly to winter wheat, grain, and alfalfa. Control of water erosion is the main management problem. Both continuous vegetation and mechanical practices generally are needed on cropland. Areas of Canyon soils should not be used for crops and should not be crossed by terraces. Proper range use provides adequate protection for areas still in native grass. (Keith and Rosebud in Silty range site, capability unit IIIe-1, windbreak group 2; Canyon in Shallow range site, capability unit VIs-2, not placed in a windbreak group)

Keith and Ulysses silt loams, 5 to 9 percent slopes (KuC).—These soils are on upland drainage divides and ridges across the southern half of the county. The areas range up to 600 acres in size. Some areas contain mainly Keith soils, some contain mainly Ulysses soils, and some contain both soils. Where they occur together, Ulysses soils are on the upper part of the slopes or on knolls and Keith soils are on the longer side slopes. The Keith soils are calcareous at a depth of 15 to 20 inches.

Included in the areas mapped are small bodies of Colby soils on the tops of ridges and knolls. Also included are areas of Goshen, Kadoka, Rosebud, and Richfield soils. Inclusions make up less than 15 percent of any given area.

This mapping unit is suited to use both as cropland and as range. Most areas in the western part of the county are in native grass and are used for grazing and hay. Scattered areas in the central and eastern parts are in crops, mainly winter wheat. Control of erosion and conservation of moisture are the main management problems. Both vegetative and mechanical practices are needed to protect cropped areas. Proper range use provides adequate erosion control for areas still in native grass. (Silty range site, capability unit IIIe-1, windbreak group 2)

Kyle Series

This series consists of deep, nearly level, firm, moderately dark colored soils that crack when dry. These soils formed in clay material. They are on terraces and fans in the northeastern part of the county.

In a typical profile, the surface layer is about 5 inches thick. It is gray to olive-gray clay of weak platy and moderate subangular blocky or granular structure. It is slightly hard when dry and firm when moist.

The subsoil, about 27 inches thick, is clay of weak to moderate prismatic and blocky or subangular blocky structure. It is olive gray in the upper part and light olive gray in the lower part. This layer is hard or very hard when dry and firm or very firm when moist. It is calcareous below a depth of about 14 inches and has many spots of soft lime and visible salt crystals below a depth of 18 inches.

The underlying material is calcareous silty clay loam that is stratified with silty clay and contains fine rounded pebbles and a few fine chips of clay shale. It is hard when dry and friable or firm when moist.

Kyle soils are moderately well drained to well drained, have moderate fertility, and are in poor tilth. Surface

runoff is slow to medium, and permeability is slow. Much of the water enters vertical cracks, which form as the soils dry. The water-holding capacity is high, but water is released slowly to plants.

The native vegetation consists mainly of mid grasses and small amounts of short grasses. Most areas are in native grass and are used for grazing and hay. Some areas that were once cultivated have been seeded to tame grasses. A few tracts are still used for crops, mainly spring-sown grain, sorghum, and alfalfa.

Profile of a Kyle clay in tame grass pasture, located 600 feet south and 1,200 feet west of the NE. corner of sec. 3, T. 43 N., R. 35 W.

Ap1—0 to 2 inches, gray (5Y 5/1) clay, dark grayish brown (2.5Y 4/2) when moist; weak, medium and coarse, platy structure breaking to moderate, coarse, granular; slightly hard when dry, firm when moist; neutral; abrupt, smooth boundary.

Ap2—2 to 5 inches, olive-gray (5Y 5/2) clay, dark grayish brown (2.5Y 4/2) when moist; moderate, medium and fine, subangular blocky structure breaking to moderate, medium, granular; slightly hard when dry, firm when moist; neutral; abrupt, smooth boundary.

B21—5 to 14 inches, olive-gray (5Y 5/2) clay, grayish brown (2.5Y 5/2) when moist; weak, coarse, prismatic structure breaking to moderate, coarse, blocky; hard when dry, firm when moist; thin patchy clay films; mildly alkaline; clear, smooth boundary.

B22—14 to 18 inches, light olive-gray (5Y 6/2) clay, grayish brown (2.5Y 5/2) when moist; moderate, very coarse, platy structure breaking to moderate, medium and fine, subangular blocky; hard when dry, firm when moist; thin continuous clay films; calcareous; few, fine, distinct segregations of soft lime; moderately alkaline; abrupt, smooth boundary.

B3ca—18 to 32 inches, light olive-gray (5Y 6/2) clay, dark grayish brown (2.5Y 4/2) when moist; weak, coarse, prismatic structure breaking to moderate, coarse, blocky; very hard when dry, very firm when moist; thin patchy clay films; calcareous; common, medium, distinct segregations of soft lime and few nests of salt crystals; moderately alkaline; clear, smooth boundary.

C1—32 to 50 inches, light brownish-gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) when moist; structureless; hard when dry, firm when moist; few, fine, rounded pebbles and few fine chips of shale; calcareous; few, fine, distinct segregations of soft lime and few nests of salt crystals; moderately alkaline; gradual, smooth boundary.

C2—50 to 55 inches, grayish-brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) when moist; structureless; hard when dry, firm when moist; calcareous; moderately alkaline; clear, smooth boundary.

C3—55 to 60 inches, light-gray (2.5Y 7/2) silty clay loam, grayish brown (2.5Y 5/2) when moist; structureless; hard when dry, friable when moist; calcareous; mildly alkaline.

The A horizon ranges from 2 to 6 inches in thickness and from clay to silty clay in texture. A light-gray crust, about ¼ inch thick, forms when the soils are dry. The B horizon ranges from 16 to 36 inches in thickness. The C horizon is clay in many areas but is stratified in places with coarser material. In places the soil material abruptly overlies shale below a depth of 40 inches. Ordinarily, these soils are calcareous at or near the surface. Vertical cracks up to 1 inch wide extend through the subsoil.

Kyle soils have a thicker subsoil and are deeper to shale than Pierre soils. They are darker colored and less alkaline than Swanboy soils.

Kyle clay, alkali, 0 to 3 percent slopes (KyA).—This soil is on terraces and flats along the White River and its tributaries. The areas generally are long and narrow and less than 40 acres in size. The texture is silty clay in some places.

Included in the areas mapped are small bodies of Hisle and Swanboy soils. Most of these inclusions are on the outer edges of stream valleys. They make up less than 10 percent of any given area.

Most areas are in native grass and are used for grazing and hay. A few are in spring-sown grain, sorghum, and alfalfa. Some that were once cultivated have been seeded to grass. This soil is slowly permeable. It is hard when dry and puddles easily when wet. The surface becomes granulated and is susceptible to soil blowing if left bare. Management needs include timely tillage and maintenance of the organic-matter content. Summer fallow is not a suitable practice. (Clayey range site, capability unit IVs–1, not placed in a windbreak group)

Loamy Land

Loamy land (0 to 6 percent slopes) (Lm) is made up of mixed, calcareous, loamy soil material. It is on long, nearly level and gentle slopes in Badland basins in the northern part of the county (fig. 6). It is drained by gullies. The material ranges from light-colored to dark-colored loam or silt loam over light-colored material of about the same texture. The structure is weak prismatic and blocky. The horizontal breakage planes are more distinct than the vertical ones. Included in the areas mapped are small bodies of clayey material similar to Clayey land and small areas of Epping, Kadoka, and Ulysses soils. Inclusions usually make up less than 20 percent of any given area.

Most areas are in native grass and are used for grazing and hay. Some areas near ranch headquarters are in crops, mainly oats, barley, sorghum, alfalfa, and tame grasses. Most of the soil material is high in lime, low in organic-matter content, and low in natural fertility. It is subject to both water erosion and soil blowing where the vegetation is sparse. Proper range use helps to control erosion in areas still in native grass. Grasses and legumes protect cropland. (Silty range site, capability unit VIe–1, windbreak group 2)

Figure 6.—**An area of Loamy land surrounded by Barren badlands. Photograph furnished by Bureau of Indian Affairs.**

Manter Series

The Manter series consists of deep, nearly level to undulating, friable, dark-colored soils on high terraces and tablelands in the northern part of the county. These soils formed in moderately sandy material over stratified sand and gravelly sand.

In a typical profile, the surface layer is about 9 inches thick. It is grayish-brown loam and fine sandy loam of weak subangular blocky and granular structure. The upper part is soft when dry and very friable when moist, and the lower part is slightly hard when dry and friable when moist.

The subsoil is about 15 inches thick. It is grayish-brown to light brownish-gray sandy loam that is slightly more clayey than the surface layer. It has weak or very weak prismatic and weak to moderate subangular blocky structure and is slightly hard when dry and friable or very friable when moist.

The underlying material is calcareous, light-gray sandy loam. It is structureless and is soft when dry and very friable when moist. In it are white streaks of soft lime. Loamy sand occurs at a depth of about 40 inches.

Manter soils are well drained and moderately fertile. Runoff is slow to medium, permeability is moderately rapid, and the water-holding capacity is moderate.

The native vegetation is a mixture of tall, mid, and short grasses. The tall grasses have been grazed out in some areas. Many areas are used for grazing, and some are cultivated. Winter wheat, oats, barley, corn, sorghum, and alfalfa are the main crops. A few areas that were once cultivated have been seeded to tame grasses.

Manter soils in this county are mapped only with Tuthill soils.

Profile of a Manter loam in a cultivated area, located 2,140 feet west and 800 feet north of the SE. corner of sec. 18, T. 43 N., R. 39 W.

Ap—0 to 5 inches, grayish-brown (10YR 5/2) loam, very dark brown (10YR 2/2) when moist; weak, medium, subangular blocky structure breaking to weak, fine, granular; soft when dry, very friable when moist; neutral; abrupt, wavy boundary.

A12–5 to 9 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, subangular blocky structure breaking to weak, fine, granular; slightly hard when dry, friable when moist; neutral; abrupt, smooth boundary.

B2t—9 to 17 inches, grayish-brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, prismatic structure breaking to moderate, coarse, subangular blocky; slightly hard when dry, friable when moist; contains more clay than horizons above; mildly alkaline; clear, smooth boundary.

B3—17 to 24 inches, light brownish-gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) when moist; very weak, coarse, prismatic structure breaking to weak, coarse, subangular blocky; slightly hard when dry, very friable when moist; mildly alkaline; abrupt, wavy boundary.

C1ca—24 to 40 inches, light-gray (10YR 7/2) coarse sandy loam, grayish brown (10YR 5/2) when moist; structureless; soft when dry, very friable when moist; calcareous; common, medium, distinct segregations of soft lime; moderately alkaline; gradual, smooth boundary.

C2—40 to 60 inches, light-gray (10YR 7/2) coarse loamy sand, grayish brown (10YR 5/2) when moist; structureless; loose; calcareous; moderately alkaline.

The A horizon ranges from 4 to 9 inches in thickness and from loam or silt loam to loamy fine sand in texture. The B horizon ranges from 8 to 20 inches in thickness and from loam to coarse sandy loam in texture. The depth to lime segregations ranges from 15 to 36 inches. The C horizon ranges from light gray to light yellowish brown in color and influences the color of the lower B horizon. The C horizon is stratified in many places with fine to coarse sand and contains a few rounded pebbles.

Manter soils have less clay in the subsoil than Tuthill soils. They are better developed than Anselmo soils, which lack a B horizon. The depth to calcareous material is less in Manter soils than in Anselmo and Tuthill soils.

Minatare Series

This series consists of deep, nearly level, firm, light-colored, saline soils that have a claypan. These soils formed in alluvium on upland valleys and flats.

In a typical profile, the surface layer, about 2 inches thick, is gray loam of weak platy and granular structure. It is soft when dry and very friable when moist.

The subsoil is about 11 inches thick. The upper part is grayish-brown clay loam of weak columnar and weak to moderate subangular blocky structure. It is hard when dry and firm when moist. The lower part is calcareous, light brownish-gray clay loam of very weak prismatic and subangular blocky structure. It is slightly hard when dry and friable when moist. In it are fine streaks and spots of lime and salts.

The underlying material is calcareous, light-gray to light-brown very fine sandy loam. It is structureless and is soft when dry and friable when moist. Fine spots of soft lime are in the upper part. Below a depth of 50 inches, there are reddish-yellow streaks and spots.

Minatare soils are poorly drained, have low fertility, and are in poor tilth. The water table is near the surface for short periods in spring and recedes to a depth of 5 feet or more late in summer. Runoff is slow, and permeability is very slow.

The native vegetation is a mixture of tall, mid, and short grasses. Low fertility, salts, and poor tilth make these soils unsuitable for cultivation.

Minatare soils in this county are mapped only in a complex with Mosher soils.

Profile of a Minatare loam, located 1,990 feet east and 980 feet north of the SW. corner of sec. 35, T. 44 N., R. 36 W.

A2—0 to 2 inches, gray (10YR 6/1) loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, platy structure breaking to weak, fine, granular; soft when dry, very friable when moist; mildly alkaline; abrupt, wavy boundary.

B21t—2 to 4 inches, grayish-brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) when moist; weak, medium and coarse, columnar structure breaking to weak, medium and fine, subangular blocky; hard when dry, firm when moist; tops and sides of columns coated with gray (10YR 6/1); moderate patchy clay films; moderately alkaline; clear, wavy boundary.

B22t—4 to 8 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) when moist; weak, medium, prismatic structure breaking to moderate, medium and fine, blocky and subangular blocky; hard when dry, firm when moist; thin continuous and moderate patchy clay films; strongly alkaline; clear, wavy boundary.

B3sa—8 to 13 inches, light brownish-gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) when moist;

very weak, medium, prismatic structure breaking to weak, medium and fine, subangular blocky; slightly hard when dry, friable when moist; thin very patchy clay films; calcareous; common, fine, distinct, soft segregations of salts and soft lime; strongly alkaline; gradual, wavy boundary.

C1ca—13 to 36 inches, light-gray (10YR 7/2) loam, grayish brown (10YR 5/2) when moist; very weak, medium, subangular blocky structure in upper part breaking to massive in lower part; soft when dry, friable when moist; calcareous; few, fine, distinct segregations of soft lime; very strongly alkaline; gradual boundary.

C2—36 to 50 inches, light-brown (7.5YR 6/4) very fine sandy loam, brown (7.5YR 5/4) when moist; structureless; soft when dry, friable when moist; calcareous; very strongly alkaline; gradual boundary.

C3g—50 to 60 inches, light-brown (7.5YR 6/4) and dark grayish-brown (7.5YR 4/2) very fine sandy loam, brown (7.5YR 5/4) and very dark grayish brown (7.5YR 3/2) when moist; structureless; soft when dry, friable when moist, slightly sticky when wet; few, medium, distinct, reddish-yellow (7.5YR 6/6) segregations of iron, yellowish red (7.5YR 5/6) when moist; calcareous; strongly alkaline.

The A horizon ranges from 1 to 5 inches in thickness and from very fine sandy loam to silt loam in texture. The B horizon ranges from 5 to 15 inches in thickness. The upper part is sandy clay loam to clay. The C horizon is variable in texture and is layered in places with material of contrasting texture.

Minatare soils are lighter colored, are more saline, and have a thinner surface layer and subsoil than Mosher soils.

Mosher Series

The Mosher series consists of deep, nearly level, firm, dark-colored soils that have a claypan. These soils formed in alluvium on flats and terraces. The water table is at a depth of 4 to 7 feet in some places.

In a typical profile, the surface layer is about 7 inches thick. It is gray to dark-gray silt loam of weak platy, subangular blocky, and granular structure. The subsurface layer, about 3 inches thick, is gray silt loam of weak platy, subangular blocky, and granular structure. These layers are soft when dry and friable or very friable when moist.

The subsoil is about 14 inches thick. The upper part is gray clay of moderate columnar and strong blocky structure. It is extremely hard when dry and very firm when moist. The lower part is calcareous, light brownish-gray clay loam of weak prismatic and strong blocky structure. It is extremely hard when dry and firm when moist.

The underlying material is calcareous, light brownish-gray silty clay loam that has spots and streaks of soft lime and salts. Below a depth of 34 inches there is light-gray, calcareous, stratified silt loam, loam, and clay loam.

Mosher soils are somewhat poorly drained and have moderate fertility. Runoff is slow, and permeability is slow to very slow.

The native vegetation consists of mid and short grasses. Most areas are in native grass and are used for grazing and hay. Winter wheat, tame grasses, and alfalfa are grown in a few areas, but a claypan, salts in the underlying material, and occasional wetness limit the use for these crops.

Profile of a Mosher silt loam in native grass pasture, located 580 feet east and 300 feet south of the NW. corner of sec. 25, T. 43 N., R. 39 W.

A11—0 to 3 inches, gray (10YR 5/1) silt loam, very dark brown (10YR 2/2) when moist; weak, fine, platy structure breaking to weak, medium, granular; soft when dry, very friable when moist; neutral; abrupt, smooth boundary.

A12—3 to 7 inches, dark-gray (10YR 4/1) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, platy and medium subangular blocky structure breaking to weak, medium, granular; soft when dry, friable when moist; neutral; abrupt, smooth boundary.

A2—7 to 10 inches, gray (10YR 6/1) silt loam, dark gray (10YR 4/1) when moist; weak, coarse, platy and medium subangular blocky structure breaking to weak, medium, granular; soft when dry, friable when moist; neutral; abrupt, wavy boundary.

B21t—10 to 15 inches, gray (10YR 5/1) clay, very dark grayish brown (10YR 3/2) when moist; moderate, coarse and medium, columnar structure breaking to strong, medium and coarse, blocky; extremely hard when dry, very firm when moist; moderately thick continuous clay films; moderately alkaline; clear, wavy boundary.

B22t—15 to 24 inches, light brownish-gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, prismatic structure breaking to strong, coarse, blocky; extremely hard when dry, firm when moist; moderately thick continuous clay films; calcareous; strongly alkaline; gradual, wavy boundary.

C1casa—24 to 34 inches, light brownish-gray (10YR 6/2) silty clay loam, grayish brown (10YR 5/2) when moist; weak, coarse, subangular blocky structure; hard when dry, firm when moist; calcareous; common fine spots of soft lime and salts; strongly alkaline; gradual boundary.

C2—34 to 64 inches, light-gray (10YR 7/2) clay loam stratified with darker colored layers of silt loam and loam, grayish brown (10YR 5/2) when moist; structureless; hard when dry, friable when moist; calcareous; strongly alkaline.

The A horizon ranges from 5 to 12 inches in thickness and from silt loam and loam to very fine sandy loam in texture. The B horizon ranges from 10 to 30 inches in thickness. The C horizon ranges from loamy sand to clay in texture. Buried dark-colored layers are common in the underlying alluvium.

Mosher soils are darker colored and have a thicker surface layer and subsoil than Minatare soils. They lack a siltstone substratum, which occurs in Wortman soils.

Mosher-Minatare complex (0 to 3 percent slopes) (Mm).—Mosher soils make up 70 to 85 percent of this complex, and Minatare soils 15 to 30 percent. These are claypan soils on terraces in the northern part of the county. The relief is uneven and broken, and there are depressions up to 15 feet in diameter and 2 to 12 inches deep. Minatare soils are in the depressions, and Mosher soils are in the larger areas between the depressions. The surface layer of these soils includes loam, silt loam, and very fine sandy loam.

Included in the areas mapped are small bodies of Keith, Richfield, and Tuthill soils. These inclusions are in the better drained parts of the complex and make up less than 15 percent of any given area.

Most areas are in native grass and are used for grazing and hay. A few areas are in crops, mainly winter wheat, tame grasses, and alfalfa, but the complex is better suited to forage crops than to cultivated crops. Management needs include the maintenance of a vegetative cover of forage plants. (Mosher in Claypan range site, capability unit IVs–2, windbreak group 5; Minatare in Thin Claypan range site, capability unit VIs–1, windbreak group 6)

Oglala Series

The Oglala series consists of friable, dark-colored soils on rolling uplands in the southern part of the county. These soils formed in loamy to silty material over soft, fine-grained sandstone.

In a typical profile, the surface layer, about 8 inches thick, is grayish-brown loam. The upper part has weak, fine, granular structure and is soft when dry and very friable when moist. The lower part has weak prismatic and subangular blocky structure and is slightly hard when dry and friable when moist.

Below this layer is about 10 inches of pale-brown loam of very weak prismatic and subangular blocky structure. It is slightly hard when dry and friable when moist.

The underlying material is pale-brown coarse silt loam. It is structureless and is soft when dry and friable when moist. In the lower part are a few fine bits of weathered sandstone. Calcareous, very fine grained sandstone occurs at a depth of 36 inches.

Oglala soils are well drained and have moderate fertility. They are subject to water erosion and soil blowing. Runoff is medium to rapid, and permeability is moderate.

The native vegetation consists of mid and short grasses. Most areas are in native grass and are used for grazing and hay. Some of the more gently sloping areas are cultivated.

Profile of an Oglala loam in native grass pasture, located 790 feet south and 15 feet east of the NW. corner of sec. 30, T. 40 N., R. 39 W.

A11—0 to 3 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; neutral; clear, smooth boundary.

A12—3 to 8 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 3/2) when moist; weak, coarse, prismatic structure breaking to weak, medium, subangular blocky; slightly hard when dry, friable when moist; mildly alkaline; clear, smooth boundary.

AC—8 to 18 inches, pale-brown (10YR 6/3) loam, dark brown (10YR 4/3) when moist; very weak, coarse, prismatic structure breaking to very weak, medium and fine, subangular blocky; slightly hard when dry, friable when moist; mildly alkaline; gradual, wavy boundary.

C—18 to 36 inches, pale-brown (10YR 6/3) coarse silt loam, brown (10YR 5/3) when moist; structureless; soft when dry, friable when moist; few fine bits of weathered sandstone in lower part; mildly alkaline; abrupt boundary.

R—36 to 60 inches, very pale brown (10YR 8/3) very fine grained sandstone, pale brown (10YR 6/3) when moist; bedded; weakly indurated; calcareous; moderately alkaline.

The A horizon ranges from 5 to 15 inches in thickness and from loam and very fine sandy loam to silt loam in texture. Loam is the most common texture. The AC horizon has no observable increase in clay content over that of the surface layer. Carbonates occur at a depth of 25 to 45 inches, either in the C horizon or in the R horizon. Soft, fine-grained sandstone ordinarily occurs within 5 feet of the surface. It ranges from white to very pale brown in color and influences the color of the soil and soil material above it.

Oglala soils are deeper and darker colored than Canyon soils. They have a weaker structured subsoil that contains less clay than that of Keith and Rosebud soils. Oglala soils are less silty and are deeper to lime than Ulysses soils. They contain less sand and finer sand than Anselmo soils.

Oglala-Canyon complex, 9 to 18 percent slopes (OcE).—Oglala soils make up 40 to 60 percent of this complex, Canyon soils 20 to 40 percent, and other soils less than 20 percent. The areas are rolling and are on uplands in the southern part of the county. They range up to 1,000 acres or more in size. Oglala soils are on the mid and lower slopes below ridges. Canyon soils are on the ridgetops, the shorter convex side slopes, and the shoulders of drainageways.

Included in mapping the larger areas of this complex were small bodies of Colby, Keith, and Ulysses soils. These soils are on well-rounded ridges and knolls and on slopes that face south and east. Also included were small bodies of Goshen and Rosebud soils. Goshen soils are on foot slopes and in upland swales. Rosebud soils are on small drainage divides and on side slopes above the Oglala soils and below the Canyon soils.

Nearly all areas are in native grass and are used for grazing. A few small tracts, usually those on Oglala soils, are cultivated or have been seeded to tame grasses.

The steepness of the slopes and the pattern of occurrence of Canyon soils make growing of crops impractical in most areas. Water erosion is a hazard in areas that lack a good plant cover. Proper range use controls erosion in areas still in native grass. Seeding and mechanical measures, such as contour furrowing, help to restore range that is in poor condition. (Oglala in Silty range site, capability unit VIe–1, windbreak group 2; Canyon in Shallow range site, capability unit VIs–2, not placed in a windbreak group)

Pierre Series

This series consists of moderately deep, gently sloping to rolling, firm, moderately dark colored soils on uplands in the northeastern part of the county.

In a typical profile, the surface layer is about 2 inches thick. It is grayish-brown clay of weak platy to moderate granular structure. It is slightly hard when dry, firm when moist, and very sticky and plastic when wet.

The subsurface layer, about 3 inches thick, is calcareous, grayish-brown clay of weak to moderate prismatic, subangular blocky, and granular structure. It is slightly hard when dry, firm when moist, and very sticky and plastic when wet.

The subsoil is about 24 inches thick. It is calcareous, light brownish-gray to light-gray clay of weak to moderate prismatic or blocky structure. It is very hard or extremely hard when dry, firm or very firm when moist, and sticky or very sticky and very plastic when wet.

The underlying material is calcareous, bedded clay and weathered shale. It is hard when dry, firm when moist, and sticky and plastic when wet. There are a few fine spots of soft lime and nests of gypsum crystals. This layer grades to bedded shale at a depth of about 35 inches.

Pierre soils are well drained, have moderate fertility, and are in fair to poor tilth. Surface runoff is medium to rapid, and permeability is slow. The water-holding capacity is high, but water is released slowly to plants.

The native vegetation consists of mid and short grasses. Most areas are in native grass and are used for grazing and hay. Only a few small tracts are in crops.

Profile of a Pierre clay in native grass pasture, located 1,380 feet west and 50 feet south of the NE. corner of sec. 28, T. 44 N., R. 33 W.

A11—0 to 2 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) when moist; weak, very thin, platy structure breaking to moderate, medium and fine, granular; slightly hard when dry, firm when moist, very sticky and plastic when wet; neutral; abrupt, smooth boundary.

A12—2 to 5 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) when moist; weak, medium, prismatic structure breaking to weak, medium, subangular blocky and moderate, medium, granular; slightly hard when dry, firm when moist, very sticky and plastic when wet; thin very patchy clay films on prism faces; calcareous; moderately alkaline; abrupt, smooth boundary.

B21—5 to 13 inches, light brownish-gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) when moist; weak to moderate, medium, prismatic structure breaking to moderate, medium, blocky; very hard when dry, firm when moist, very sticky and very plastic when wet; dark organic stains along root channels; thin continuous clay films; calcareous; moderately alkaline; clear, smooth boundary.

B22—13 to 19 inches, light brownish-gray (2.5Y 6/2) clay, grayish brown (2.5Y 5/2) when moist; weak, coarse, prismatic structure breaking to moderate, coarse, blocky; extremely hard when dry, very firm when moist, sticky and very plastic when wet; thin continuous clay films; few angularly oriented slickensides; calcareous; moderately alkaline; clear, smooth boundary.

B3—19 to 29 inches, light brownish-gray (2.5Y 6/2) clay, grayish brown (2.5Y 5/2) when moist; moderate, coarse, blocky structure; extremely hard when dry, very firm when moist, sticky and very plastic when wet; thin patchy clay films; common angularly oriented slickensides; calcareous; moderately alkaline; abrupt, smooth boundary.

C&R—29 to 35 inches, light brownish-gray (2.5Y 6/2) clay and shale, grayish brown (2.5Y 5/2) when moist; bedded; calcareous; few fine spots of soft lime and nests of gypsum crystals; mildly alkaline; gradual boundary.

R—35 to 60 inches, light olive-gray (5Y 6/2) shale, olive gray (5Y 5/2) when moist; bedded; common, medium, distinct, brownish-yellow iron stains and dark-gray manganese stains; shale faces coated with soft lime in upper part; mildly alkaline.

The A horizon ranges from 2 to 6 inches in thickness and includes clay and silty clay textures. In places it is calcareous. The B horizon ranges from 10 to 30 inches in thickness and has weak to moderate prismatic and blocky structure. Cracks up to 1 inch wide extend downward through the B horizon when the soil is dry. The depth to shale ranges from 18 to 40 inches. The shale ranges from pale olive to dark gray in color and influences the color of the soil and soil material above the shale.

Pierre soils are better developed than Samsil soils and are deeper to shale. They are less deep to shale than Kyle soils and are less saline in the lower part of the subsoil.

Pierre clay, 3 to 9 percent slopes (PeC).—This soil is on uplands in the northeastern part of the county. The areas range up to 150 acres in size.

Included in the areas mapped are small bodies of Hisle, Kyle, and Samsil soils. Hisle soils are on foot slopes and along upland drainageways. Kyle soils are on the lower end of the longer slopes, and Samsil soils are on the crests. Inclusions make up less than 15 percent of any given area.

Most areas are in native grass and are used for grazing and hay. A few small tracts are in crops, mainly spring-sown grain, sorghum, alfalfa, and tame grasses. Control of water erosion and soil blowing is the main problem, but conservation of moisture and improvement of tilth also are important. Proper range use provides adequate control of erosion for areas still in native grass. Cropland needs more intensive management. (Clayey range site, capability unit IVe–4, windbreak group 3)

Pierre-Samsil clays, 9 to 25 percent slopes (PsE).—Pierre soils make up 50 to 80 percent of this complex, and Samsil soils 20 to 50 percent. These soils are in the northeastern part of the county, on the side slopes of the valleys of intermittent streams. The areas range up to 200 acres in size. The slope is less than 20 percent in most places. Pierre soils are on the longer and smoother side slopes and, in some places, have a gradient of less than 9 percent. They have a thinner subsoil than is typical for the series; the depth to shale is about 24 inches in many areas. Samsil soils are on the shorter and steeper slopes, ridges, points, and shoulders of drainageways.

Included in the areas mapped are Hisle, Kyle, and Swanboy soils. Kyle soils are on foot slopes, and Hisle and Swanboy soils are along drainageways. Some of the ridges are rounded and are capped with mixed gravelly material similar to Gravelly land.

All of this complex is in native grass and is used for grazing. The soils are too erodible for safe cultivation. Gullies start easily in places where the vegetation has been destroyed. Proper range use helps to control erosion, and range interseeding and contour furrowing help to restore range that is in poor condition. (Pierre in Clayey range site, capability unit VIe–1, windbreak group 3; Samsil in Shallow range site, capability unit VIs–2, not in a windbreak group)

Richfield Series

This series consists of deep, nearly level to sloping, friable, dark-colored soils that have a firm clayey subsoil (fig. 7). These soils are on upland divides and high terraces.

In a typical profile, the surface layer, about 10 inches thick, is dark-gray to grayish-brown silt loam. It has weak platy to granular structure in the upper 6 inches and very weak to moderate prismatic, subangular blocky, and granular structure in the lower part. It is slightly hard when dry and very friable when moist.

The subsoil is silty clay loam and silt loam about 24 inches thick. It is grayish brown to brown in the upper part and pale brown in the lower part. It has weak to moderate prismatic, blocky, and granular structure and is slightly hard to very hard when dry and firm to friable when moist.

The underlying material is calcareous, light brownish-gray to very pale brown silt loam. It is structureless and is soft when dry and friable when moist.

Richfield soils are well drained, have high fertility, and are in good tilth. Surface runoff is slow to medium, permeability is moderately slow, and the water-holding capacity is high.

The native vegetation consists of mid and short grasses. Some areas are in native grass and are used for grazing and hay. Many areas are in crops, mainly winter wheat.

Figure 7.—**Profile of a Richfield silt loam.**

Profile of a Richfield silt loam in native grass pasture, located 1,000 feet south and 900 feet east of the NW. corner of sec. 22, T. 41 N., R. 40 W.

A11—0 to 6 inches, dark-gray (10YR 4/1) silt loam, black (10YR 2/1) when moist; weak, thin, platy structure breaking to weak, fine, granular; slightly hard when dry, very friable when moist; neutral; abrupt, smooth boundary.

A12—6 to 10 inches, grayish-brown (10YR 5/2) silt loam, very dark brown (10YR 2/2) when moist; very weak, very coarse, prismatic structure breaking to weak, coarse, subangular blocky and moderate, medium, granular; slightly hard when dry, very friable when moist; neutral; clear, smooth boundary.

B1—10 to 12 inches, grayish-brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, prismatic structure breaking to weak, coarse, subangular blocky and moderate, medium, granular; hard when dry, friable when moist; thin patchy clay films; neutral; clear, smooth boundary.

B2t—12 to 21 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) when moist; moderate, coarse, prismatic structure breaking to moderate, coarse and medium, blocky; very hard when dry, firm when moist; prisms partly coated with grayish-brown color from the B1 horizon; thin continuous clay films; mildly alkaline; gradual, smooth boundary.

B31—21 to 31 inches, pale-brown (10YR 6/3) silty clay loam, dark grayish brown (10YR 4/2) when moist; weak, fine, prismatic structure breaking to moderate, fine, blocky; very hard when dry, friable when moist; thin patchy clay films; mildly alkaline; clear, smooth boundary.

B32ca—31 to 34 inches, pale-brown (10YR 6/3) silt loam, dark grayish brown (10YR 4/2) when moist; weak, medium and fine, subangular blocky structure; slightly hard when dry, friable when moist; calcareous; few, fine, faint, soft lime segregations; mildly alkaline; abrupt, smooth boundary.

C1ca—34 to 45 inches, light-gray (10YR 7/2) silt loam, brown (10YR 5/3) when moist; structureless; soft when dry, friable when moist; calcareous; common fine threads of soft lime; moderately alkaline; gradual boundary.

C2—45 to 61 inches, very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) when moist; structureless; soft when dry, friable when moist; few, fine, reddish-yellow to strong-brown iron stains; calcareous; few fine threads of soft lime; moderately alkaline.

The A horizon ranges from 2 to 12 inches in thickness and from dark gray to grayish brown in color. The B horizon ranges from 12 to 30 inches in thickness and includes silty clay loam and silty clay textures of 35 to 45 percent clay. The depth to lime ranges from 18 to 40 inches. The C horizon is usually silt loam to a depth of more than 5 feet, but in places it changes abruptly at a depth of 40 inches to weathered geologic material containing bits of sandstone or siltstone. Sand and gravel occur below a depth of 40 inches in the northern part of the county.

Richfield soils have more clay in the subsoil than Keith soils and, in most places, a thicker surface layer. The subsoil is lighter colored, browner, and more clayey than that of Goshen soils.

Richfield and Keith silt loams, 0 to 3 percent slopes (RkA).—These soils are on divides in the central and southern parts of the county and on high terraces in the northern part. The areas range up to 500 acres in size. Some consist mainly of Richfield soils, some mainly of Keith soils, and some of both soils. In some places the Keith soils have a thicker surface layer than is typical for the series. In the northern part of the county, the underlying material of both soils changes abruptly to sand or gravelly sand below a depth of 40 inches.

Included in the areas mapped are small bodies of Goshen and Hoven soils. The Goshen soils occur in long, narrow areas along ill-defined drainageways. The Hoven soils are in small depressions where water ponds. Inclusions make up less than 5 percent of any given area.

Most areas of this mapping unit are cultivated. Winter wheat is the main crop, but oats, barley, corn, sorghum, and alfalfa also are grown. Some areas are in native grass and are used for grazing and hay. Conservation of moisture is the main management problem. Soil blowing is a hazard. Management needs include maintenance of organic-matter content and tilth. Proper range use provides adequate control of erosion for areas still in native grass. (Silty range site, capability unit IIc–1, windbreak group 2)

Richfield and Keith silt loams, 3 to 9 percent slopes (RkC).—These soils are mostly in the central and southern parts of the county. Some areas consist mainly of Richfield soils, some mainly of Keith soils, and some of both soils. Richfield soils are on the lower end of long smooth slopes, and Keith soils are on the upper end. Most areas have a slope of less than 5 percent. Some areas of Richfield soils that have slopes of 5 to 9 percent have a surface layer only 2 to 5 inches thick.

Included in the areas mapped are small bodies of Goshen, Kadoka, and Rosebud soils. Goshen soils are along upland drainageways; Kadoka and Rosebud soils are on the

crests of slopes. These inclusions make up less than 10 percent of any given area.

Many areas of this mapping unit are in crops. Winter wheat is the main crop, but oats, barley, corn, sorghum, and alfalfa also are grown. Some areas are in native grass and are used for grazing and hay. The control of water erosion is the main problem, but the maintenance of good tilth also is a problem in cultivated areas of Richfield soils. Good management of crop residue controls erosion where the slope range is 3 to 5 percent. More intensive measures are needed where the slope range is 5 to 9 percent. Proper range use provides adequate control of erosion for areas still in native grass. (Silty range site, capability unit IIe-1, windbreak group 2)

Rosebud Series

This series consists of moderately deep, gently sloping to rolling, friable, dark-colored soils on uplands in the southern part of the county. These soils formed in material weathered from soft, fine-grained sandstone.

In a typical profile, the surface layer is about 6 inches thick. It is dark-gray loam of weak platy, subangular blocky, and granular structure. It is soft when dry and very friable when moist.

The subsoil is about 16 inches thick. It is grayish-brown loam or clay loam in the upper part and pale-brown loam or clay loam in the lower part. It has weak prismatic and weak to moderate subangular blocky structure and is hard or slightly hard when dry and friable to firm when moist.

The underlying material consists of calcareous, very pale brown loam that contains many fragments of fine-grained sandstone. It grades to bedded, soft, fine-grained sandstone at a depth of 36 inches.

Rosebud soils are well drained. They have moderate fertility and are easy to work. Runoff is medium, and permeability is moderate.

The native vegetation consists of mid and short grasses. Some gently sloping areas are cultivated. Winter wheat is the main crop, but oats, barley, corn, sorghum, and alfalfa also are grown.

Rosebud soils in Washabaugh County are mapped only as complexes with Keith and Canyon soils.

Profile of a Rosebud loam in native grass pasture, located 258 feet west and 1,295 feet south of the center of sec. 18, T. 40 N., R. 35 W.

A11—0 to 2 inches, dark-gray (10YR 4/1) loam, black (10YR 2/1) when moist; weak, thin, platy structure breaking to weak, fine, granular; soft when dry, very friable when moist; neutral; abrupt, smooth boundary.

A12—2 to 6 inches, dark-gray (10YR 4/1) loam, very dark brown (10YR 2/2) when moist; weak, medium, subangular blocky structure breaking to weak, medium, granular; soft when dry, very friable when moist; neutral; clear, smooth boundary.

B1—6 to 8 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, prismatic structure breaking to weak, medium and fine, subangular blocky; slightly hard when dry, friable when moist; thin patchy clay films; neutral; abrupt, irregular boundary.

B2t—8 to 17 inches, grayish-brown (10YR 5/) clay loam, dark brown (10YR 3/3) when moist; weak, medium, prismatic structure breaking to moderate, medium, subangular blocky; hard when dry, firm when moist; prisms partly coated with dark gray from the A horizon; thin continuous clay films; mildly alkaline; clear, smooth boundary.

B3—17 to 22 inches, pale-brown (10YR 6/3) clay loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, prismatic structure breaking to weak, coarse, subangular blocky; slightly hard when dry, firm when moist; thin patchy clay films; mildly alkaline; abrupt, wavy boundary.

Cca&R—22 to 36 inches, very pale brown (10YR 8/3) loam, pale brown (10YR 6/3) when moist; bedded; soft when dry, friable when moist; many fragments and chunks of fine-grained sandstone; calcareous; common, fine, distinct segregations of soft lime; moderately alkaline; gradual boundary.

R—36 to 52 inches, very pale brown (10YR 7/3), weakly indurated, fine-grained sandstone, brown (10YR 5/3) when moist; bedded; calcareous; moderately alkaline.

The A horizon ranges from 4 to 9 inches in thickness and includes loam, very fine sandy loam, and silt loam textures. The B horizon ranges from 10 to 24 inches in thickness and from loam to clay loam or silty clay loam in texture. It contains more clay than the A horizon. In places the A horizon and the upper part of the B horizon formed in silty material. Bits and fragments of sandstone are in the B horizon in many places. The depth to lime ranges from 15 to 32 inches; the soil becomes calcareous either in the lower part of the B horizon or in the C horizon. The depth to the Cca&R or R horizon ranges from 16 to 40 inches. The R horizon is typically at a depth of more than 20 inches. The materials consist of soft very fine sand that ranges from white to very pale brown in color. In places there is a distinct layer of lime-cemented sandstone or caliche.

Rosebud soils are deeper than Canyon soils, which lack a B horizon. They are calcareous nearer the surface than Oglala soils. Rosebud soils are less silty than Kadoka and Keith soils. The underlying material is harder than that under Keith and Ulysses soils.

Samsil Series

This series consists of shallow, gently sloping to hilly or steep, firm soils over clay shale. These soils are on uplands in the northeastern part of the county.

In a typical profile, the surface layer is about 2 inches thick. It is calcareous, grayish-brown clay of strong granular structure. It is slightly hard when dry and firm when moist.

Below this layer is about 3 inches of calcareous, light brownish-gray clay of weak subangular blocky and granular structure. It is slightly hard when dry and firm when moist.

The underlying material is calcareous, light brownish-gray clay that contains fine chips of gray shale. It is structureless and is slightly hard when dry and firm when moist. This material grades to weathered bedded shale at a depth of 15 inches.

Samsil soils are somewhat excessively drained to excessively drained. They are shallow to shale, have low fertility, and are easily eroded. Surface runoff is rapid, and permeability is slow.

The native vegetation consists of thin stands of mid and short grasses. Almost all areas are in native grass and are used for grazing.

Profile of a Samsil clay in native grass pasture, located 1,340 feet west and 1,440 feet north of the SE. corner of sec. 28, T. 44 N., R. 33 W.

A1—0 to 2 inches, grayish-brown (2.5Y 5/2) clay, olive brown (2.5Y 4/3) when moist; strong, medium and fine, granular structure; slightly hard when dry, firm

when moist, sticky when wet; calcareous; moderately alkaline; abrupt, smooth boundary.

AC—2 to 5 inches, light brownish-gray (2.5Y 6/2) clay, light olive brown (2.5Y 5/3) when moist; weak, medium, subangular blocky structure breaking to weak, medium and fine, granular; slightly hard when dry, firm when moist, sticky and plastic when wet; few fine chips of gray shale; calcareous; moderately alkaline; clear, smooth boundary.

C—5 to 15 inches, light brownish-gray (2.5Y 6/2) clay, light olive brown (2.5Y 5/3) when moist; structureless; slightly hard when dry, firm when moist, sticky and plastic when wet; common fine chips of gray shale with some faces stained light yellowish brown (2.5Y 6/4, 5/4) when moist; few, large, distinct spots of soft lime; few nests of gypsum crystals; calcareous; moderately alkaline; gradual boundary.

R1—15 to 30 inches, light olive-gray (5Y 6/2) and gray (5Y 7/1) weathered shale, olive (5Y 5/3) and gray (5Y 5/1) when moist; bedded; few large spots of soft lime and few nests of gypsum crystals; calcareous; moderately alkaline; gradual boundary.

R2—30 to 60 inches, bedded shale, only slightly altered by weathering; mildly alkaline.

The A1 horizon ranges from 1 to 6 inches in thickness and and includes clay and silty clay textures. Small broken fragments of shale are scattered on the surface and through the soil in many places. In some places the A horizon is noncalcareous, or the soils are weakly calcareous throughout. The AC horizon ranges up to 12 inches in thickness. The depth to bedded shale ranges from 6 to 20 inches. The shale ranges from light olive brown to pale olive and dark gray in color and strongly influences the color of the soil.

Samsil soils lack the B horizon of the Pierre soils and are more shallow to shale. They are less alkaline than Hisle soils.

Samsil-Pierre clays, 9 to 25 percent slopes (SpE).—Samsil soils make up 50 to 75 percent of this complex, and Pierre soils 25 to 50 percent. These soils are on uplands in the northeastern part of the county. The areas range up to 600 acres or more in size. Most areas have a slope of less than 20 percent. Samsil soils are on ridges and the upper side slopes. Pierre soils are on the longer and more gentle mid and lower slopes. They have a thinner subsoil than is typical for the Pierre series; the depth to shale is only about 20 inches in many places.

Included in the areas mapped are Hisle, Kyle, and Swanboy soils. Hisle soils are on foot slopes, along small drainageways, and in slight depressions on drainage divides. Kyle and Swanboy soils are on fans and small flats along drainageways. Also included are outcrops of shale, ordinarily less than 1 acre in size. They are around the heads of drainageways on the upper part of slopes. Inclusions make up less than 10 percent of any given area.

All of this complex is in native grass and is used for grazing. Control of water erosion is the main management problem. Gullies form easily in the channels of drainageways, along stock trails, or wherever else the vegetation is in poor condition. Proper range use is the most practical way to control erosion; range interseeding helps to restore the grass stand where it has deteriorated. (Samsil in Shallow range site, capability unit VIs–2, not in a windbreak group; Pierre in Clayey range site, capability unit VIe–1, windbreak group 3)

Samsil-Shale outcrop complex (9 to 40 percent slopes) (Ss).—Samsil soils make up 50 to 70 percent of this complex, Shale outcrop 15 to 35 percent, and other soils 5 to 25 percent. The texture of the surface layer is dominantly silty clay and clay. The areas are along the White River and its tributaries in the northeastern part of the county. The slopes are broken and irregular, and the gradient exceeds 20 percent in many areas. Many drainageways are gullied. Samsil soils and Shale outcrop are closely intermingled. Shale outcrop consists of eroded exposures of clay shale and is common on the upper slopes, around the heads of small drainageways. The areas range from less than 1 acre to 20 acres in size. Landslides are common next to the White River.

Included in the areas mapped are bodies of Pierre soils up to 15 acres in size. These soils are on the longer and more gentle slopes. Also included are smaller bodies of Hisle, Kyle, and Swanboy soils on foot slopes and fans along drainageways.

All of this complex is used for grazing. Shale outcrop is bare or nearly so. Control of water erosion is the main management problem. Proper range use is the only practical way to protect most areas. (Samsil in Shallow range site, capability unit VIIs–2, not placed in a windbreak group; Shale outcrop in capability unit VIIIs–1, not placed in a range site or windbreak group)

Swanboy Series

The Swanboy series consists of deep, very firm, light-colored soils. These soils formed in dense clay alluvium washed from outcrops of clay and clay shale on adjacent slopes. They occur in upland valleys and on fans and low stream terraces in the northern part of the county.

In a typical profile, the surface layer is about 1 inch thick. It is light brownish-gray clay and has a thin, light-gray crust. Beneath this layer is about 15 inches of calcareous, light-gray clay. The structure is moderate subangular blocky and strong blocky. The material is extremely hard when dry and extremely firm when moist.

The underlying material is calcareous, light-gray, stratified clay, silty clay loam, and silty clay. The upper part has weak subangular blocky to moderate blocky structure and is extremely hard when dry and very firm when moist. There are many spots and streaks of soft lime and salt segregations.

Swanboy soils are well drained. They have low fertility and are in poor tilth. Surface runoff is medium to rapid, and permeability is very slow. Swanboy soils release moisture slowly to plants.

The native vegetation consists of sparse stands of mid grasses. All areas are used for grazing. None are suitable for cultivation.

Profile of Swanboy clay in native grass pasture, located 2,240 feet north and 400 feet west of the SE. corner of sec. 18, T. 43 N., R. 40 W.

A1—0 to 1 inch, light brownish-gray (10YR 6/2) clay, grayish brown (10YR 5/2) when moist; light-gray (10YR 7/1) crust about ¼ inch thick, gray (10YR 5/1) when moist; moderate, medium, granular structure; hard when dry, firm when moist, sticky and plastic when wet; calcareous; moderately alkaline; abrupt, smooth boundary.

AC—1 inch to 16 inches, light-gray (10YR 7/2) clay, grayish brown (10YR 5/2) when moist; moderate, coarse, subangular blocky structure breaking to strong, medium and fine, blocky; extremely hard when dry; ex-

tremely firm when moist, sticky and very plastic when wet; calcareous; strongly alkaline; clear, smooth boundary.

C1sa—16 to 23 inches, light-gray (10YR 7/2) clay, light brownish gray (10YR 6/2) when moist; weak, medium, subangular blocky structure breaking to moderate, fine, blocky; extremely hard when dry, very firm when moist, sticky and very plastic when wet; calcareous; common, medium, prominent, soft lime and salt segregations; strongly alkaline; abrupt, smooth boundary.

C2—23 to 60 inches, light-gray (10YR 7/2) stratified silty clay loam, silty clay, and clay, light brownish gray (10YR 6/2) when moist; slightly hard to extremely hard when dry, friable to very firm when moist; calcareous; few, fine, distinct, soft lime and salt segregations; strongly alkaline.

The A1 horizon ranges from ½ inch to 2 inches in thickness. The AC horizon ranges from 6 to 20 inches in thickness and has weak to strong blocky structure. Vertical cracks up to 2 inches in diameter extend downward through these layers when the soils are dry. The color, which ranges from pale olive and light olive gray to light gray, depends on the source of the clay sediments. The material is strongly calcareous where the sediments were derived from Badland clay and weakly calcareous where they were derived from clay shale.

Swanboy soils are deeper to shale than Pierre and Samsil soils. They are more alkaline, lighter colored, and less well developed than Kyle soils, which have a distinct B horizon.

Swanboy clay (0 to 6 percent slopes) (Sw).—This is a crusty, dense clay soil in the northern part of the county. It occurs in Badland basins and on foot slopes and fans. The areas are mostly less than 50 acres in size. The slope is less than 3 percent in most places.

Included in the areas mapped are small bodies of Hisle, Kyle, and Pierre soils. Included in the Badland basins are areas similar to Clayey land and Loamy land. Inclusions make up less than 15 percent of any given area.

All of this Swanboy soil is in native grass, which is used for grazing but not for hay. Strong alkalinity, very slow permeability, and low fertility are the main limitations. The response to water spreading generally is not satisfactory. Proper range use is essential for protection of the sparse grass cover. Seeding helps to restore the grass cover where the range is in poor condition. (Dense Clay range site, capability unit VIIs–1, not placed in a windbreak group)

Terrace Escarpments

Terrace escarpments (9 to 30 percent slopes) (Te) are made up of moderately steep to steep terrace fronts. Much of this land type is in the northern part of the county. The slopes are short, and the gradient generally exceeds 18 percent. The soil material is variable in texture but ranges from loam to clay in most areas. There are pockets of sand and gravel in some places, but the areas are not so gravelly as Gravelly land. Included in the areas mapped are small bodies of Colby, Epping, Samsil, and Valentine soils.

This land type supports sparse stands of mid and short grasses. All areas are used for grazing. Erosion is a hazard where the vegetation is inadequate. Proper range use is the best way to control erosion. The short, steep slopes make seeding and other mechanical treatment impractical. (Shallow range site, capability unit VIIs–2, not placed in a windbreak group)

Tuthill Series

This series consists of deep, nearly level and undulating, friable, dark-colored soils. These soils occur on uplands, tablelands, and high terraces in almost all parts of the county.

In a typical profile, the surface layer is about 12 inches thick. The upper part is grayish-brown fine sandy loam and has weak subangular blocky to granular structure. The lower part is dark grayish-brown fine sandy loam of weak prismatic, subangular blocky, and granular structure. This layer is soft when dry and very friable when moist.

The subsoil is about 26 inches thick. The upper part is brown sandy clay loam of weak prismatic and subangular blocky structure. It is slightly hard when dry and friable when moist. The middle part is grayish-brown to pale-brown sandy clay loam of moderate prismatic and blocky structure. It is hard when dry and firm when moist. The lower part is pale-brown sandy clay loam of weak subangular blocky structure. It is slightly hard when dry and friable when moist.

The underlying material is pale-brown sand that is structureless and loose. Below a depth of 54 inches, it is calcareous and contains a few pebbles.

Tuthill soils are well drained and have moderate fertility. Runoff is slow to medium, permeability is moderate, and the water-holding capacity is high.

The native vegetation consists mainly of mid and short grasses, but there are some tall grasses. Most areas in the western part of the county are in native grass and are used for grazing and hay. Many areas in the eastern part are cultivated. Winter wheat, oats, barley, corn, sorghum, and alfalfa are grown.

Profile of a Tuthill fine sandy loam in native grass pasture, located 2,620 feet west and 30 feet south of the NE. corner of sec. 12, T. 41 N., R. 37 W.

A11—0 to 4 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, subangular blocky structure breaking to weak, medium, granular; soft when dry, very friable when moist; neutral; abrupt, smooth boundary.

A12—4 to 12 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, prismatic structure breaking to weak, medium, subangular blocky and fine granular; soft when dry, very friable when moist; neutral; clear, smooth boundary.

B21t—12 to 16 inches, brown (10YR 5/3) sandy clay loam, dark brown (10YR 3/3) when moist; weak, medium, prismatic structure breaking to weak, medium, subangular blocky; slightly hard when dry, friable when moist; neutral; clear, smooth boundary.

B22t—16 to 24 inches, grayish-brown (10YR 5/2) sandy clay loam, dark grayish brown (10YR 4/2) when moist; moderate, coarse, prismatic structure breaking to moderate, coarse, blocky; hard when dry, firm when moist; thin patchy clay films; many dark-gray worm casts; neutral; clear, smooth boundary.

B23t—24 to 35 inches, pale-brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) when moist; moderate, medium, prismatic and subangular blocky structure; hard when dry, firm when moist; thin patchy clay films; dark-gray worm casts common; mildly alkaline; clear, smooth boundary.

B3—35 to 38 inches, pale-brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) when moist; weak, medium, subangular blocky structure; slightly hard when dry,

friable when moist; thin very patchy clay films; mildly alkaline; abrupt, smooth boundary.

IIC1—38 to 54 inches, pale-brown (10YR 6/3) sand, brown (10YR 5/3) when moist; structureless; loose; mildly alkaline; gradual boundary.

IIC2—54 to 60 inches, very pale brown (10YR 7/3) sand, pale brown (10YR 6/3) when moist; structureless; loose; few fine pebbles; calcareous; mildly alkaline.

The A horizon ranges from 5 to 16 inches in thickness and from sandy loam to loam in texture. The B horizon ranges from 10 to 30 inches in thickness and typically is sandy clay loam in texture. In places the B horizon shows an increase in content of silt as well as in content of clay. The depth to lime ranges from 30 to 60 inches or more. In the southern and central parts of the county, there is bedded sandstone or siltstone below a depth of 40 inches. In the northern part, the C horizon is stratified in places with material of contrasting texture ranging from loam to sand. There are lenses of coarse sand and fine rounded quartz gravel.

Tuthill soils have a more clayey subsoil than Manter soils. They are less silty and more sandy than Keith soils.

Tuthill and Anselmo fine sandy loams, 0 to 3 percent slopes (TnA).—These soils are on tablelands in the northern part of the county and on uplands in the central and southeastern parts. Some areas consist mainly of Tuthill soils, a few mainly of Anselmo soils, and many of more nearly equal amounts of both soils. Tuthill soils are on the smoother slopes, and Anselmo soils are on short, very gently undulating slopes.

Included in the areas mapped are small bodies of Manter soils. Inclusions make up less than 15 percent of any given area.

About half the acreage of these soils is cultivated. Spring-sown grain, corn, sorghum, and alfalfa are the main crops. Control of soil blowing is the main management problem. Management that includes the maintenance of organic-matter content and preservation of soil structure helps to control blowing. Proper range use provides adequate control of erosion for areas still in native grass. (Sandy range site, capability unit IIIe–2, windbreak group 1)

Tuthill and Anselmo fine sandy loams, 3 to 9 percent slopes (TnC).—These soils are on tablelands in the northern part of the county and on uplands in the central and southeastern parts. The areas range up to 500 acres in size. Some consist mainly of Tuthill soils, some mainly of Anselmo soils, and some of more nearly equal amounts of each. Tuthill soils are on the longer slopes. Anselmo soils are on the upper slopes and are dominant in the more undulating areas. In places both soils have a thinner surface layer and subsoil than is typical for the series.

Included in the areas mapped are bodies of Manter soils. These inclusions are on the upper part of slopes and ordinarily make up less than 20 percent of any given area.

Most areas are in native grass and are used for grazing and hay. Some are cultivated. Spring-sown grain, corn, sorghum, and alfalfa are the main crops. Control of soil blowing is the main management problem. Water erosion is a hazard on the steeper slopes if the vegetative cover is not adequate for protection. Management that includes the maintenance of a cover of growing vegetation and the use of crop residue helps to control erosion of cropland. Proper range use provides adequate control of erosion for areas still in native grass. (Sandy range site, capability unit IVe–3, windbreak group 1)

Tuthill and Manter soils, 0 to 3 percent slopes (TuA).—These soils are mostly on high terraces and tablelands in the northern part of the county. Some areas consist mainly of Tuthill soils, some mainly of Manter soils, and some of more nearly equal amounts of each. Tuthill soils are in the more nearly level areas. Manter soils are on very slight rises or in slightly undulating areas and are more loamy than typical. The surface layer of both soils ranges from fine sandy loam to loam.

Included in the areas mapped are small bodies of Altvan, Goshen, Keith, and Richfield soils. Altvan, Keith, and Richfield soils are nearly level. Goshen soils are in slight depressions along ill-defined drainageways. Inclusions make up less than 10 percent of any given area.

Many areas are in winter wheat, oats, barley, corn, sorghum, and alfalfa. Other areas are in native grass and are used for grazing and hay. Moisture conservation is the main management problem. Soil blowing is a hazard. Management that includes maintenance of the organic-matter content and preservation of soil structure helps to conserve moisture and control erosion on cropland. Proper range use provides adequate protection for areas still in native grass. (Tuthill in Silty range site, capability unit IIIe–2, windbreak group 1; Manter in Sandy range site, capability unit IIIe–2, windbreak group 1)

Tuthill and Manter soils, 3 to 5 percent slopes (TuB).—These soils are on tablelands in the northern part of the county. The areas range up to 400 acres in size. Some consist mainly of Tuthill soils, some mainly of Manter soils, and some of more nearly equal amounts of each. Tuthill soils are on the longer and smoother slopes and are more loamy than typical. Manter soils are on the upper part of slopes and are coarser textured than typical. The surface layer of both soils is variable.

Included in the areas mapped are small bodies of Altvan, Anselmo, Goshen, and Keith soils. Inclusions make up less than 15 percent of any given area.

Many areas are in winter wheat, oats, barley, corn, sorghum, and alfalfa. Some areas are in native grass and are used for grazing and hay. Control of water erosion and soil blowing and conservation of moisture are the main management problems. Management that includes the use of crop residue for maintenance of the organic-matter content and preservation of soil structure helps to control erosion on cropland. Proper range use provides adequate control of erosion for areas still in native grass. (Tuthill in Silty range site, capability unit IIIe–3, windbreak group 1; Manter in Sandy range site, capability unit IIIe–3, windbreak group 1)

Tuthill and Manter soils, 5 to 9 percent slopes (TuC).—These soils are on tablelands and terrace fronts in the northern part of the county. They occur in an irregular pattern. Some areas consist only of Tuthill soils, some only of Manter soils, and some of both soils. Tuthill soils are on the longer and smoother slopes, and Manter soils are on the shorter upper slopes. Both soils have a thinner surface layer than is typical for the series. The texture is loam or fine sandy loam.

Included in the areas mapped are bodies of Altvan, Anselmo, Goshen, Keith, and Ulysses soils. On the tops of rounded ridges and knolls are inclusions of a shallow soil similar to Gravelly land. Inclusions make up as much as 20 percent of a given area in places.

Most areas are in native grass and are used for grazing and hay. A few areas are in crops, mainly spring-sown

grain, sorghum, and alfalfa. Control of water erosion and soil blowing and conservation of moisture are management problems. Proper range use provides adequate control of erosion for areas still in native grass. Tuthill in Silty range site, capability unit IVe-3, windbreak group 1; Manter in Sandy range site, capability unit IVe-3, windbreak group 1)

Ulysses Series

This series consists of deep, gently sloping, friable, dark-colored soils on uplands. These soils formed in loess and occur throughout most of the county.

In a typical profile, the surface layer is about 8 inches thick. It is grayish-brown or dark grayish-brown silt loam of weak granular, prismatic, and blocky structure. It is soft when dry and friable or very friable when moist.

The subsoil, about 5 inches thick, is pale-brown silt loam of weak prismatic or blocky structure. It is slightly hard when dry and friable when moist.

The underlying material is calcareous, light-gray to very pale brown silt loam. It is structureless and is slightly hard to soft when dry and friable when moist.

Ulysses soils are well drained and have moderate fertility. Surface runoff is medium, permeability is moderate, and the water-holding capacity is high.

The native vegetation consists of mid and short grasses. Most areas are in native grass and are used for grazing and hay. Some are in crops, mainly winter wheat.

Ulysses soils in this county are mapped only with Keith soils.

Profile of a Ulysses silt loam in native grass pasture, located 900 feet south and 300 feet east of the NW. corner of sec. 9, T. 41 N., R. 38 W.

A11—0 to 3 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, granular structure; soft when dry, very friable when moist; neutral; abrupt, smooth boundary.

A12—3 to 8 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) when moist; weak, medium, prismatic structure breaking to weak, fine, subangular blocky and weak, medium, granular; soft when dry, friable when moist; neutral; clear, smooth boundary.

B2—8 to 13 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; weak, coarse, prismatic structure breaking to moderate, medium, subangular blocky; slightly hard when dry, friable when moist; mildly alkaline; clear, wavy boundary.

C1ca—13 to 22 inches, light-gray (10YR 7/2) silt loam, light brownish gray (10YR 6/2) when moist; structureless; slightly hard when dry, friable when moist; calcareous; moderately alkaline; clear, wavy boundary.

C2—22 to 64 inches, very pale brown (10YR 7/3) silt loam, pale brown (10YR 6/3) when moist; structureless; soft when dry, friable when moist; calcareous; moderately alkaline.

The A horizon ranges from 3 to 8 inches in thickness. It is silt loam in most places but is loam and very fine sandy loam in some. The B horizon ranges from 4 to 12 inches in thickness and has little or no increase in clay content over the A horizon. In places the B horizon is calcareous. The depth to lime ranges from 5 to 15 inches.

Ulysses soils have a less clayey subsoil than Keith soils and are calcareous nearer the surface. They have a thicker and darker colored surface layer and are deeper to lime than Colby soils. They are less deep to lime and contain more silt and clay than Oglala soils.

Valentine Series

In this series are deep, undulating to hilly, loose, light-colored soils on uplands. These soils formed in sand that has been deposited or locally reworked by wind.

In a typical profile, the surface layer is about 2 inches thick. It is loose, brown sand of very weak platy structure breaking to single grain. Below this is about 7 inches of loose, pale-brown sand that has very weak prismatic structure.

The underlying material is pale-brown coarse loamy sand to a depth of 34 inches and pale-brown calcareous sand below that depth.

Valentine soils are excessively drained. They are low in fertility and are susceptible to soil blowing. Surface runoff is very slow, and permeability is very rapid. The water-holding capacity is low, but moisture is released readily to plants.

The native vegetation consists mainly of tall and mid grasses. All areas are in native grass and are used for grazing.

Profile of Valentine sand in native grass pasture, located 1,340 feet east of the NW. corner of sec. 12, T. 42 N., R. 40 W.

A1—0 to 2 inches, brown (10YR 5/3) sand, very dark grayish brown (10YR 3/2) when moist; very weak, medium, platy structure breaking to single grain; loose; neutral; abrupt, smooth boundary.

AC—2 to 9 inches, pale-brown (10YR 6/3) sand, dark grayish brown (10YR 4/2) when moist; very weak, coarse, prismatic structure; loose; neutral; clear, smooth boundary.

C1—9 to 34 inches, pale-brown (10YR 6/3) coarse loamy sand, brown (10YR 5/3) when moist; structureless; loose; neutral; gradual boundary.

C2—34 to 60 inches, pale-brown (10YR 6/3) sand, grayish brown (10YR 5/2) when moist; structureless; loose; calcareous; mildly alkaline.

The A1 and AC horizons combined range from 4 to 15 inches in thickness and from sand to loamy fine sand in texture. In the northern part of the county, the C horizon contains thin layers of coarse sand. This layer generally is free of lime but is calcareous, in places, below a depth of 30 inches. In the central and southeastern parts of the county, the underlying sand changes abruptly, in places, to loamy or silty material below a depth of 40 inches.

Valentine soils are lighter colored, more sandy, and looser than Anselmo soils.

Valentine sand (3 to 30 percent slopes) (Vs). This is an undulating to hilly soil on uplands. It occurs in several parts of the county. On the east side of Pass Creek, in the southeastern part of the county, are areas as much as 500 acres in size. Here, the soil is undulating and the slope range is chiefly 3 to 9 percent. West of the town of Wanblee, the soil is on stringers of sand that extend in a northwest-southeast direction and have a slope of up to 15 percent. Areas in the northern part of the county are rolling to hilly. The surface layer is mostly sand but includes loamy fine sand.

Included in the areas mapped are small bodies of Anselmo and Manter soils on foot slopes. In the northern part of the county, outcrops of Gravelly land are included. There are a few sand blowouts up to 3 acres in size. Inclusions generally make up less than 15 percent of any given area.

All of this Valentine soil is in native grass and is used for grazing. It has a good cover of tall and mid grasses,

but careful management is needed to control erosion and to prevent the expansion of blowouts. (Sands range site, capability unit VIe–2, windbreak group 7)

Wanblee Series

This series consists of moderately deep, nearly level to gently sloping, firm, light-colored soils that have a claypan. These soils are in upland swales and on foot slopes and fans. They occur in all parts of the county.

In a typical profile, the surface layer is about 2 inches thick. It is light brownish-gray very fine sandy loam of weak platy and granular structure. It is soft when dry and very friable when moist.

The subsoil is about 8 inches thick. The upper part is grayish-brown clay loam of moderate to strong columnar and moderate blocky structure. It is very hard when dry and very firm when moist. The lower part is calcareous, pale-brown silty clay loam of weak prismatic and moderate blocky structure. It is hard when dry and firm when moist.

The underlying material is calcareous, very pale brown silt loam. It is structureless and is hard when dry and friable when moist. In it are many fine segregations of lime and salts. This material grades to white or pinkish-white silt loam and siltstone at a depth of 28 inches.

Wanblee soils are somewhat poorly drained, have low fertility, and are in poor tilth. Runoff is slow, and water ponds in low spots. Permeability is very slow. Moisture is yielded slowly to plants.

The natural vegetation consists of sparse stands of mid and short grasses. The low ponded spots either are bare or have only a sparse cover. Almost all areas are in native grass and are used for grazing. Wanblee soils are not suitable for cultivation.

Profile of a Wanblee very fine sandy loam in native grass pasture, located 2,340 feet west and 50 feet north of the SE. corner of sec. 29, T. 41 N., R. 35 W.

A2—0 to 2 inches, light brownish-gray (10YR 6/2) very fine sandy loam, very dark grayish brown (10YR 3/2) when moist; thin light-gray (10YR 6/1) crust about ¼ inch thick; weak, very thin, platy structure breaking to weak, fine, granular; soft when dry, very friable when moist; neutral; abrupt, wavy boundary.

B21t—2 to 4 inches, grayish-brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) when moist; moderate to strong, medium, columnar structure breaking to moderate, medium and fine, blocky; very hard when dry, very firm when moist; thin continuous clay films; moderately alkaline; abrupt, wavy boundary.

B22t—4 to 10 inches, pale-brown (10YR 6/3) silty clay loam, brown (10YR 5/3) when moist; weak, coarse, prismatic structure breaking to moderate, medium, blocky; hard when dry, firm when moist; thin continuous clay films; calcareous; few fine threads of soft lime; strongly alkaline; clear, smooth boundary.

Csa—10 to 28 inches, very pale brown (10YR 8/3) silt loam, light yellowish brown (10YR 6/4) when moist; structureless; hard when dry, friable when moist; calcareous; many fine threads of soft lime and salts; strongly alkaline; gradual boundary.

C&R—28 to 41 inches, white (10YR 8/2) silt loam and siltstone, light gray (10YR 7/2) when moist; structureless; slightly hard when dry, friable when moist; calcareous; moderately alkaline; gradual boundary.

R—41 to 60 inches, pinkish-white (7.5YR 8/2) siltstone, brown (7.5YR 5/3) when moist; bedded; mildly alkaline.

The A horizon ranges from ½ inch to 4 inches in thickness and from very fine sandy loam to silt loam in texture. The B horizon has weak to strong columnar structure in the upper part. It ranges from 4 to 15 inches in thickness and from clay loam to silty clay in texture. The B horizon ordinarily is calcareous. The C horizon is variable, but bedded silt and siltstone are usually within 40 inches of the surface. In some valleys, bedded clay ranging from pale yellow to pinkish gray and gray in color is within a depth of 40 inches.

Wanblee soils are lighter colored, have a thinner surface layer and subsoil, and are strongly alkaline nearer the surface than Wortman soils. They are underlain by harder material than Minatare soils. Wanblee soils are less clayey than Hisle soils, which are underlain by clay shale.

Wanblee soils (0 to 6 percent slopes) (Wa).—These are claypan soils in Badland basins and valleys in the northern part of the county. The slopes are plane to concave and uneven. There are mounds and low spots that have a difference in elevation of 2 to 4 inches. The texture of the surface layer depends on the source of the local alluvium in which the upper part of this soil formed. This layer is 2 to 4 inches thick on the mounds and less than 2 inches thick in the low spots. The subsoil is calcareous; visible salts are usually within 12 inches of the surface. The underlying material is stratified in places with material of contrasting texture ranging from loamy very fine sand to silty clay. In most places bedded silt and siltstone or Badland clay is within a depth of 40 inches.

Included in the areas mapped are small bodies of Hisle and Wortman soils. Hisle soils occur where erosion has exposed the clay shale. Wortman soils are on the broader mounds. Inclusions usually make up less than 20 percent of any given area.

All of this mapping unit is in native grass and is used for grazing. Management needs include the maintenance of an adequate grass cover. Range seeding helps to restore stands that are in poor condition. (Thin Claypan range site, capability unit VIs–1, not placed in a windbreak group)

Wet Alluvial Land

Wet alluvial land (0 to 3 percent slopes) (We) is made up of mixed soil material. It is on narrow flood plains along Pass Creek in the southeastern part of the county and in spring-fed upland swales and narrow valleys throughout the county. The material ranges from loamy sand to silty clay in texture and from light shades to black in color. The depth to the water table usually ranges from 2 to 7 feet. Included in the areas mapped are bodies of Minatare and Mosher soils.

All of this land type is in native grass and is used for grazing and hay. The high water table makes cultivation impractical, but it does favor the growth of tall and mid grasses. This vegetation should be maintained. (Subirrigated range site, capability unit Vw–1, windbreak group 4)

Wortman Series

In this series are moderately deep to deep, nearly level and gently sloping, firm, dark-colored soils that have a claypan. These soils are in upland swales and on foot slopes, fans, and stream flats. They occur in most parts of the county.

In a typical profile, the surface layer is about 8 inches thick. The upper part is grayish-brown silt loam of weak platy, granular, and subangular blocky structure. The lower part is light brownish-gray silt loam of weak platy and granular structure. This layer is soft to slightly hard when dry and friable or very friable when moist.

The subsoil is about 15 inches thick. The upper part is grayish-brown silty clay of moderate columnar and strong blocky structure. It is extremely hard when dry and very firm when moist. The middle part is brown silty clay of weak prismatic and strong blocky structure. It is very hard when dry and very firm when moist. The lower part is calcareous, brown silty clay loam of moderate blocky structure. It is hard when dry and friable when moist.

The underlying material is calcareous, pale-brown to light-gray silt loam. It is structureless and is slightly hard to soft when dry and friable when moist. In it are many streaks and spots of soft lime and many nests of salt crystals. Pinkish-white siltstone occurs at a depth of 50 inches.

Wortman soils are moderately well drained and have moderate fertility. Runoff is slow, and permeability is slow to very slow. Moisture is released slowly to plants, and the development of plant roots is inhibited.

The native vegetation consists of mid and short grasses. Many areas are in native grass and are used for grazing and hay. Some are cultivated. Winter wheat, oats, barley, and alfalfa are the main crops.

Profile of a Wortman silt loam in a cropped area, located 2,540 feet east and 200 feet north of the SW. corner of sec. 17, T. 40 N., R. 35 W.

Ap—0 to 4 inches, grayish-brown (10YR 5/2) silt loam, very dark brown (10YR 2/2) when moist; weak, thick, platy structure breaking to weak, medium and fine, granular; soft when dry, very friable when moist; neutral; abrupt, smooth boundary.

A12—4 to 6 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, subangular blocky structure breaking to weak, medium, granular; slightly hard when dry, friable when moist; neutral; abrupt, wavy boundary.

A2—6 to 8 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) when moist; weak, thick, platy structure breaking to weak, medium, granular; slightly hard when dry, friable when moist; neutral; abrupt, wavy boundary.

B21t—8 to 13 inches, grayish-brown (10YR 5/2) silty clay, very dark grayish brown (10YR 3/2) when moist; moderate, medium, columnar structure breaking to strong, medium, blocky; extremely hard when dry, very firm when moist; moderately thick continuous clay films; mildly alkaline; clear, smooth boundary.

B22t—13 to 18 inches, brown (10YR 5/3) silty clay, dark grayish brown (10YR 4/2) when moist, slightly darker colored coats on peds; weak, coarse, prismatic structure breaking to strong, medium and coarse, blocky; very hard when dry, very firm when moist; thin continuous clay films; moderately alkaline; clear, irregular boundary.

B3ca—18 to 23 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) when moist; moderate, coarse, blocky structure; hard when dry, friable when moist; thin patchy clay films; calcareous; few fine threads of soft lime segregations; moderately alkaline; abrupt, wavy boundary.

C1sa—23 to 30 inches, pale-brown (10YR 6/3) silt loam, dark grayish brown (10YR 4/2) when moist; structureless; slightly hard when dry, friable when moist; calcareous; common fine threads of soft lime segregations and many nests of salt crystals; strongly alkaline; clear, wavy boundary.

C2—30 to 50 inches, light-gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) when moist; structureless; soft when dry, friable when moist; few fragments of siltstone; calcareous; few fine segregations of soft lime and few nests of salt crystals; strongly alkaline.

R—50 to 60 inches, pinkish-white (7.5YR 8/2) soft siltstone, light brown (7.5YR 6/3) when moist; bedded; calcareous; strongly alkaline.

The A horizon ranges from 4 to 11 inches in thickness and from very fine sandy loam to silt loam in texture. The lower part is light brownish gray to gray in color. The B horizon ranges from 8 to 25 inches in thickness and from clay loam to clay or silty clay in texture. The soils are calcareous at a depth of 11 to 30 inches, either in the lower B horizon or in the C horizon. The number of visible salt segregations ranges from few to many in the C horizon. Fragments of siltstone are common in the C horizon. The depth to bedded siltstone ranges from 30 to 60 inches.

Wortman soils are darker colored than Wanblee soils and have a thicker and less alkaline surface layer and subsoil. They have a harder substratum than Mosher soils.

Wortman-Wanblee complex (0 to 6 percent slopes) (Ww).—Wortman soils make up 45 to 80 percent of this complex, and Wanblee soils 20 to 55 percent. These are claypan soils in swales and on foot slopes, fans, and stream flats. They occur in most parts of the county. In areas that contain about equal amounts of Wanblee soils and Wortman soils, the surface relief is uneven and broken. Wanblee soils are in depressions, and Wortman soils are 2 to 12 inches higher. Where Wortman soils make up about 80 percent of the complex, the surface relief is relatively even.

Included in the areas mapped are small bodies of Epping and Kadoka soils. These soils occur on slight rises. In the southeastern part of the county, bodies of Mosher and Minatare soils are included. Inclusions usually make up less than 20 percent of any given area.

Many areas of this complex are in native grass and are used for grazing. The larger bodies of Wortman soils are cultivated or are used for hay crops. Winter wheat, oats, barley, alfalfa, and tame grasses are grown. Wortman soils have a slowly permeable claypan subsoil, which affects crop growth, and Wanblee soils are not suitable for cultivation. Where both soils are closely intermingled, grazing is the most practical use. (Wortman in Claypan range site, capability unit IVs-2, windbreak group 5; Wanblee in Thin Claypan range site, capability unit VIs-1, not placed in a windbreak group)

Use and Management of the Soils

This section discusses the use and management of soils as range, as cropland, for windbreaks, for wildlife, and for engineering uses.

Use of the Soils as Range[2]

Most of Washabaugh County was once covered with grass, and about 85 percent is still grass covered. Mid and short grasses grow in most of the county. Tall and mid grasses are most common in the southeastern part, near Pass Creek. The rangeland is chiefly rolling to hilly.

[2] By Ralph S. Cole, range conservationist, Soil Conservation Service.

It is accessible for grazing, except for a few isolated mesas and small tablelands in areas of Badlands.

Native grass for pasture and hay is a major crop in this county. It provides feed for breeding herds during periods of snow cover and furnishes grazing throughout the year. Beef cattle are the main kind of livestock. There are only a few sheep and hogs.

Range sites and condition classes

A range site is a distinctive kind of range that, because of its particular combination of climate, soil, and topography, is capable of producing a particular kind and amount of native vegetation. The original, or climax, vegetation is made up of plants that make best use of the natural environment and are the most productive. These plants reproduce themselves without the aid of fertilizer, irrigation, or cultivation, but the composition of the vegetation changes under intensive grazing.

Decreaser plants are part of the climax vegetation. Ordinarily, they are the tallest and most productive perennial grasses and forbs and are the most palatable to livestock. They decrease if grazed closely. Increaser plants also are a part of the climax vegetation. They commonly are short grasses and are less palatable to livestock than the decreasers. These plants increase under close grazing and replace the decreasers. Invader plants are annual grasses, weeds, and shrubs not normally a part of the climax vegetation. They invade areas where the climax vegetation is being depleted. Most invaders have little value for grazing.

Four range condition classes are recognized: excellent, good, fair, and poor. The classes are based on the degree of departure from the climax vegetation brought about by overgrazing. They show the difference between what is now growing on a particular site and the native vegetation that once grew there. A range is in excellent condition if 76 to 100 percent of the vegetation is the same kind as that in the original stand. It is in good condition if the percentage is between 51 and 75, in fair condition if the percentage is between 26 and 50, and in poor condition if the percentage is less than 25.

The following are signs of improvement in range condition: (1) the more palatable grasses are vigorous and are spreading; (2) little bare ground is visible, and there is an abundance of mulch; (3) grass is beginning to cover old gullies, and there are no active raw gullies; and (4) unwanted plants are few or lacking.

Signs that the range condition is deteriorating include the following: (1) the more palatable grasses are thinning out or are small and stunted, and the decreaser plants are disappearing; (2) little grass mulch is visible, and there are increasing areas of bare ground; (3) gully erosion is active in the natural drainageways; (4) big bluestem, little bluestem, green needlegrass, leadplant amorpha, and other desirable plants are gradually disappearing; and (5) pricklypear, fringed sagewort, curlycup gumweed, western ragweed, plantain, and other undesirable plants are gradually increasing.

Descriptions of range sites

The soils of Washabaugh County have been grouped into 12 range sites, which are described in the following paragraphs. In each description are shown important soil characteristics, principal plants, and estimates of yields. The yield estimates were based on clipping studies and grazing trials (*6*, *7*).[3] These estimates are for range in excellent condition and for seasons that have average precipitation and temperature.

To find the range site in which a given soil has been placed, and the page on which it is described, turn to the "Guide to Mapping Units." Only those soils suitable for range have been placed in a range site.

SUBIRRIGATED RANGE SITE

This site consists of Wet alluvial land. It occurs mainly as small bodies along spring-fed drainageways and on the flood plains of creeks. Most areas are in the southern part of the county. The soils are variable in texture. They generally are high in organic-matter content. The water table is near the surface early in the growing season and normally drops to a depth of 2 to 7 feet by midsummer. Moisture is within reach of plant roots during most of the growing season.

The principal decreaser plants are big bluestem, little bluestem, switchgrass, prairie cordgrass, and indiangrass. The increasers include western wheatgrass and slim sedge. The invaders include Kentucky bluegrass, foxtail barley, Canada Thistle, and verbena.

Most of this site is used for grazing. A few of the larger tracts are in hay.

If this site is in excellent condition, the total annual yield of herbage is about 4,800 pounds, air-dry weight, per acre.

OVERFLOW RANGE SITE

This site consists of nearly level mixed soils on bottom lands and upland drainageways. The water table is not within reach of plant roots, but the soils receive additional moisture from stream flooding and runoff from the adjacent slopes.

The principal decreaser plants are big bluestem, little bluestem, green needlegrass, prairie sandreed, and switchgrass. The increaser plants include western wheatgrass, needle-and-thread, side-oats grama, and blue grama. The invader plants include curlycup gumweed, Japanese brome, common sunflower, Kentucky bluegrass, kochia, and western ragweed.

Some areas of this site are in crops, mainly alfalfa, but most areas are used for grazing or native hay. Scattered clumps of trees and shrubs afford protection for livestock, and the site is often used for winter grazing. Shallow wells from which livestock can obtain water can be dug in most areas.

If this site is in excellent condition, the total annual yield of herbage is about 3,200 pounds, air-dry weight, per acre.

CLOSED DEPRESSION RANGE SITE

Hoven silt loam is the only soil in this site. It is a claypan soil that takes in water slowly. It is in closed depressions that collect runoff from the adjacent slopes. The areas are 1 to 40 acres in size but are mostly less than 10 acres. They lack outlets and consequently are ponded until the water is either absorbed or evaporated.

The major decreaser plant is western wheatgrass. Small sedges and rushes are the main increasers, and buffalo-

[3] Italic numbers in parentheses refer to Literature Cited, page 60.

grass is an increaser in some of the drier areas. Foxtail barley, knotweed, and other invaders take over if the areas are ponded for long periods or are grazed intensively and trampled when the soils are wet.

Almost all areas of this site are in native grass and are used for grazing and hay.

If this site is in excellent condition, the total annual yield of herbage is about 2,900 pounds, air-dry weight, per acre.

SANDS RANGE SITE

This site consists of deep, undulating to rolling, loose, sandy soils on uplands. It is in the southeastern, central, and northern parts of the county.

The principal decreaser plants are sand bluestem, little bluestem, big bluestem, switchgrass, and leadplant amorpha. The principal increasers are prairie sandreed and needle-and-thread; others include blue grama, hairy grama, sand dropseed, threadleaf sedge, field sagewort, and yucca. The invaders are sandbur, western ragweed, annual brome, and annual dropseed.

This site is used almost entirely for grazing. It declines rapidly if used for hay. Blowouts occur in closely grazed areas. Dune stabilization helps to restore the grass cover.

If this site is in excellent condition, the total annual yield of herbage is about 2,500 pounds, air-dry weight, per acre.

SANDY RANGE SITE

This site consists of deep, nearly level to rolling, dark-colored, coarse, loamy soils on uplands. Most areas are in the northern and central parts of the county.

The decreaser plants include prairie sandreed, little bluestem, sand bluestem, big bluestem, and switchgrass. The increaser plants include western wheatgrass, needle-and-thread, blue grama, sand dropseed, threadleaf sedge, and green sagewort. Sand sagebrush is an increaser in the northwestern part of the county. The invaders include annual brome, western ragweed, common sunflower, Russian-thistle, and plantain.

Some tracts of this site are cultivated, but most are in native grass used for grazing and hay. The tall decreaser plants have almost disappeared in some areas, and increaser plants make up a large proportion of the grass cover.

If this site is in excellent condition, the total annual yield of herbage is about 2,200 pounds, air-dry weight, per acre.

SILTY RANGE SITE

This is one of the most extensive sites in the county, and its use is important to the livestock economy. It consists of moderately deep and deep, nearly level to strongly sloping, silty and loamy soils on uplands, in all parts of the county.

The decreaser plants include western wheatgrass, green needlegrass, big bluestem, little bluestem, and prairie sandreed. The increaser plants include needle-and-thread, blue grama, fringed sagewort, and small amounts of threadleaf sedge. The invaders include annual brome, curlycup gumweed, plantain, Russian-thistle, and pricklypear.

Many of the more gently sloping areas of this site are in crops. Large areas are in native grass and are used for grazing and hay.

If this site is in excellent condition, the total annual yield of herbage is about 2,000 pounds, air-dry weight, per acre.

CLAYEY RANGE SITE

This site consists of moderately deep and deep, nearly level to sloping, clayey soils. These soils are on uplands and low terraces in the northern part of the county. They are slowly permeable.

The principal decreaser plants are western wheatgrass and green needlegrass. The increaser plants include blue grama, buffalograss, and pricklypear. The invaders include annual brome, curlycup gumweed, broom snakeweed, and common sunflower.

Most of this site is in native grass and is used for grazing and hay. Short grasses and pricklypear make up the plant cover in areas that have been heavily grazed.

If this site is in excellent condition, the total annual yield of herbage is about 1,900 pounds, air-dry weight, per acre.

THIN UPLAND RANGE SITE

In this site are thin, friable soils that formed in calcareous, silty loess. These soils are moderately permeable and are somewhat excessively drained. They occur on the tops of ridges and knolls, in all parts of the county.

The decreaser plants include little bluestem, green needlegrass, and western wheatgrass. Side-oats grama is a major increaser, and needle-and-thread, blue grama, and threadleaf sedge are minor increasers. The invaders include broom snakeweed, curlycup gumweed, and annual plants.

Most of this site is in native grass and is used for grazing. A few small tracts are cultivated.

If this site is in excellent condition, the total annual yield of herbage is about 1,800 pounds, air-dry weight, per acre.

SHALLOW RANGE SITE

This is one of the most extensive sites in the county, and its use is important to the livestock economy. It consists of nearly level to steep soils that are underlain at a depth of 5 to 20 inches by bedded siltstone, shale, sandstone, or loose gravel. These soils and the underlying material generally contain an abundance of lime. Only a few fine roots grow below a depth of 15 inches. The areas occur in all parts of the county.

The principal decreaser plants are little bluestem, western wheatgrass, green needlegrass, prairie sandreed, and, in places, small amounts of big bluestem and sand bluestem. Side-oats grama is a major increaser plant and is the first to replace the decreasers. Other increasers include needle-and-thread, blue grama, and threadleaf sedge. The invaders include broom snakeweed, plantain, curlycup gumweed, and annual brome.

Almost all of this site is used for grazing. If farmed, it should be seeded to native grass species.

If this site is in excellent condition, the total annual yield of herbage is about 1,700 pounds, air-dry weight, per acre.

CLAYPAN RANGE SITE

This site consists of nearly level to very gently sloping soils that have a surface layer 4 to 12 inches thick over a claypan. This site occurs in all parts of the county. The vegetation is moderately sparse because it is difficult for plant roots to penetrate the claypan.

The principal decreaser plants are western wheatgrass and green needlegrass. The increasers include blue grama, buffalograss, fringed sagewort, and pricklypear. The invaders include annual brome, broom snakeweed, curlycup gumweed, plantain, and common sunflower.

The soils of this site are mainly in native grass and are used for grazing.

If this site is in excellent condition, the total annual yield of herbage is about 1,600 pounds, air-dry weight, per acre.

THIN CLAYPAN RANGE SITE

This site consists of nearly level to very gently sloping soils that have a surface layer less than 4 inches thick over a claypan. Salts occur near the surface. This site occurs in all parts of the county. The vegetation is sparse; areas commonly have scattered annual weeds and weedy forbs. It is difficult for plant roots to penetrate the claypan.

The principal decreaser plant is western wheatgrass. The increaser plants include blue grama, buffalograss, inland saltgrass, fringed sagewort, and pricklypear. The invaders include annual brome, broom snakeweed, curlycup gumweed, plantain, and common sunflower.

Nearly all of this site is in native grass and is used for grazing. Many areas are in only fair condition (fig. 8). Trampling damages the grass cover if this site is grazed when wet.

If this site is in excellent condition, the total annual yield of herbage is about 1,000 pounds, air-dry weight, per acre.

DENSE CLAY RANGE SITE

This site consists of Swanboy clay, a nearly level to gently sloping, dense clay on foot slopes and alluvial fans in the northern part of the county. This soil has a very thin, crusty surface layer and a strongly alkaline subsoil that is extremely hard when dry and extremely firm when moist. Permeability is very slow. Grass roots penetrate with difficulty.

The vegetation is an almost pure stand of western wheatgrass, and there is no understory. Green needlegrass is a minor decreaser plant. The increaser plants include American vetch, yellow wildparsley, biscuitroot, and pricklypear. The invaders include broom snakeweed, common sunflower, and sweetclover.

***Figure 8.*—Thin claypan range site in fair condition.**

All of this site is in native grass and is used for grazing. The vegetation is sparse, and the ground between the plants is bare.

If this site is in excellent condition, the total annual yield of herbage is about 1,500 pounds, air-dry weight, per acre.

Range management practices

Conservation of water and control of erosion are the major management needs for range improvement in this county. Measures effective in meeting these needs include proper degree of use; proper season of use; deferment or distribution of grazing; range seeding; pitting and contour furrowing; dune stabilization; control of fire, brush, and weeds; mowing; and water spreading.

Proper degree of use, under which not more than half the yearly growth of forage is eaten, benefits all the range sites and is especially beneficial on the Sands range site. Proper season of use varies according to the range site. The sites should be grazed when the vegetation grows best. The Silty range site and the Clayey range site are examples of sites that produce cool-season grasses, such as western wheatgrass and green needlegrass. The Shallow range site and the Sands range site are examples of sites that produce warm-season grasses, such as bluestem and prairie sandreed.

Deferment of grazing is the practice of excluding livestock during part or all of a growing season. The Shallow range site and the Sands range site are examples of sites on which grazing should be deferred in summer and early in fall. The Silty range site and the Clayey range site are examples of sites on which grazing should be deferred in spring and early in summer. Distribution of grazing can be effected by fencing and by spacing water facilities and salting areas. Examples of sites benefited by the distribution of grazing are the Silty, Clayey, Sands, and Shallow range sites.

Range seeding helps to reestablish native grasses on rangeland that is in poor or fair condition and on cropland converted to range. Native grasses should be used. For example, the seeding mixture should consist of western wheatgrass and green needlegrass on the Clayey range site and the Silty range site. It should consist of little bluestem and side-oats grama on the Shallow range site and of sand bluestem, prairie sandreed, and little bluestem on the Sands range site.

Range pitting helps to retard runoff and conserve moisture. It encourages the growth of taller grasses and is beneficial if the range is in poor or fair condition. The slope should be less than 10 percent. Contour furrowing also encourages growth of the taller grasses and is suitable if the slope range is up to 20 percent. Examples of range sites benefited by pitting and furrowing are the Sandy, Silty, Clayey, Shallow, and Claypan range sites. Grazing of pitted areas should be deferred for two growing seasons.

Dunes can be stabilized by smoothing, fencing and mulching the areas, or by establishing a cover of rye or sudangrass and then seeding the range. Areas in need of dune stabilization occur within the Sands range site. Firebreaks are needed especially on such range sites as the Silty range site and the Shallow range site. Control of brush and weeds is particularly effective on the Sands range site and the Sandy range site.

The Overflow range site and the Closed Depression range site are examples of sites that usually can be mowed each year without damage. The upland sites, such as the Sandy, Silty, and Clayey range sites, should not be mowed more than once in 2 years and should not be cleared of mulch. The Overflow, Sandy, Silty, and Clayey range sites are examples of sites benefited by water spreading.

Additional information about range management can be obtained from the local offices of the Soil Conservation Service and the Bureau of Indian Affairs.

Management of Cropland [4]

Cropland makes up only about 10 percent of the total land area of this county. Most cropped areas are on Tuthill and Richfield soils, which are in the northern part of the county, and on Keith, Rosebud, and Kadoka soils, which are near Longvalley and Wanblee. In all other parts of the county, cropped areas occur only as isolated tracts within large areas of range. Winter wheat is the most important crop.

Some areas that were once used for cultivated crops have been converted to tame grasses and legumes. Keith, Richfield, and Rosebud soils are well suited to these pasture crops.

Areas used for crops need management that conserves moisture, controls erosion, and maintains tilth and fertility. Irrigation is beneficial but is not extensively used.

Conserving moisture and controlling erosion

In this county winter wheat is commonly grown in a sequence with fallow, but this practice results in erosion. In clean-fallowed areas of Keith and Rosebud soils, for example, the surface layer is likely to be blown away or to be washed away after intense summer rains. The soil material thus lost cuts off or covers up the young wheat plants.

Measures needed to conserve moisture and to control water erosion and soil blowing include crop-residue use, stubble mulching, stripcropping, a conservation cropping system, terracing and contour farming, grassed waterways, and emergency tillage.

Leaving crop residue on the surface or incorporating it into the surface layer helps to maintain the organic-matter content, to improve fertility and tilth, and to increase the capacity of the soil to absorb and retain moisture. The use of crop residue alone keeps soil losses to a minimum and helps to conserve moisture in Kadoka, Keith, Richfield, and other nearly level soils.

Stubble mulching is a system of managing residue during seedbed preparation, planting, and cultivation and after harvest so as to keep a protective cover on the surface the year round. It is effective on all cropland in the county and especially so on Anselmo, Colby, Kadoka, Keith, and Tuthill soils. The texture of the soil determines the amount of residue needed per acre. Help in determining the correct amount for a given soil can be obtained from the local office of the Soil Conservation Service or from the Bureau of Indian Affairs.

Stripcropping is the practice of alternating strips of close-growing crops with strips of row crops or of fallow. Stripcropping at right angles to the prevailing wind helps to control soil blowing. The Anselmo, Manter, and Tuthill soils are examples of soils that benefit from such protection. Stripcropping on the contour helps to control water erosion on the gently sloping soils of the Kadoka and Keith series. A cropping system that includes legumes, tame grasses, and other soil-improving, high-residue crops helps to keep the soils in good tilth and to maintain fertility. These crops may reduce the need for other practices for control of erosion on Anselmo, Colby, and Kyle soils.

Terracing and contour farming, generally used in combination, are effective practices for control of erosion and conservation of moisture on cropland that has a slope of more than 2 percent. Keith and Richfield soils are examples of soils that need such protection.

Grassed waterways are broad, grass-covered channels built to carry runoff at a nonerosive rate. They are most likely to be needed in cultivated areas of Kadoka, Keith, and Richfield soils.

Roughening the soil surface by listing, ridging, duckfooting, or chiseling is an effective practice where there is not enough crop residue or growing vegetation to protect the soils against blowing. Emergency tillage is most likely to be needed on Anselmo, Colby, Haverson, Manter, and Tuthill soils, but it may be needed on any cultivated soil during dry periods.

Maintaining tilth and fertility

Tilth and fertility are difficult to maintain in areas that have limited precipitation. Effective measures for soil improvement include the use of minimum tillage, high-residue crops, and fertilization.

Fallowed fields should be tilled only enough to control weeds. Frequent tillage of Kadoka, Keith, Richfield, and similar soils tends to pulverize the surface layer and to impair the soil structure and tilth. These soils then puddle and crust, fail to absorb water readily, and become more susceptible to blowing and to water erosion. Frequent tillage also leads to the formation of a tillage pan, or traffic pan, just below plow depth. Formation of a pan can be avoided by not working the soils when they are wet and by alternating the depth of tillage. A pan can be broken up by chiseling every third or fourth year and by growing deep-rooted legumes and grasses.

Growing high-residue crops helps to maintain the organic-matter content in Keith, Richfield, and similar soils. Green manure and manure obtained from feedlots help to maintain the organic-matter content in Anselmo and other sandy soils and in Colby, Haverson, and other soils that are high in lime content.

The soils in Washabaugh County have been cultivated for a relatively short time and generally have remained productive without applications of commerical fertilizer. High-lime soils, such as the Colby and Haverson soils, are likely to be low in available nitrogen and phosphorus. A nitrogen deficiency shows up occasionally in fields of Kadoka and Keith soils that have been in continuous cultivation for 40 years or more. Such a deficiency is most likely to occur during or after years of above-average rainfall.

Recent field trials in neighboring Bennett County show that winter wheat grown after fallow on Keith, Richfield, and Rosebud soils makes little or no response to applica-

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[4] By WALTER N. PARMETER, conservation agronomist, Soil Conservation Service.

tions of nitrogen and phosphorus. Spring-sown grain grown after another crop on Keith and Richfield soils showed only a slight response to applications of nitrogen.

The need for fertilization is likely to increase. Information about fertilization can be obtained from the local office of the Soil Conservation Service or from the Agricultural Extension Service of South Dakota State University at Brookings, S. Dak.

Irrigating

Only about 400 acres in this county is irrigated. Most of this acreage consists of Haverson soils. Pumps along the White River and wells in other parts of the county are potential sources of irrigation water. Successful irrigation requires suitable soils, enough water of good quality, and an efficient means of delivering the water. Good management requires a knowledge of how to apply the water, when to apply it, and how to distribute it evenly. Also, most soils need to be fertilized if crops are to benefit fully from irrigation. Help in planning an irrigation system can be obtained from local offices of the Soil Conservation Service, the Bureau of Indian Affairs, and the Agricultural Extension Service of South Dakota State University.

Capability Groups of Soils

Capability classification is the grouping of soils to show, in a general way, their suitability for most kinds of farming. It is a practical classification based on limitations of the soils, the risk of damage when they are used, and the way they respond to treatment when used for the common field crops and pasture plants. The classification does not apply to most horticultural crops or to rice and other crops that have special requirements. The soils are classified according to degree and kind of permanent limitation but without consideration of major and generally expensive land-forming that would change the slope, depth, or other characteristics of the soils, and without consideration of possible but unlikely major reclamation projects.

In the capability system, all kinds of soils are grouped at three levels; the capability class, the subclass, and the unit. These are discussed in the following paragraphs.

Capability Classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I. Soils have few limitations that restrict their use. No soils in Washabaugh County are in class I.

Class II. Soils have moderate limitations that reduce the choice of plants or require moderate conservation practices.

Class III. Soils have severe limitations that reduce the choice of plants, or require special conservation practices, or both.

Class IV. Soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V. Soils are subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife food and cover.

Class VI. Soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife food and cover.

Class VII. Soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to grazing, woodland, or wildlife.

Class VIII. Soils and landforms have limitations that preclude their use for commercial plant production and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes.

Capability Subclasses are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c* shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use.

Capability Units are soil groups within the subclasses. All the soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to be similar in productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIIe-1 or IVs-2. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

Management by capability units

In the following pages the capability units in Washabaugh County are described, and suggestions for use and management of the soils are discussed.

CAPABILITY UNIT IIe-1

This unit consists of deep and moderately deep, gently sloping silt loams and loams on uplands and stream terraces. In many cultivated fields these soils are slightly eroded to moderately eroded.

Tilth is good. The water-holding capacity is moderate to high, and permeability is moderate. Water erosion, soil blowing, and a periodic moisture deficiency are hazards. Management needs include control of erosion, conservation of moisture, and maintenance or improvement of fertility and tilth.

Wheat, oats, barley, rye, corn, sorghum, alfalfa, and tame grasses are suitable crops. Winter wheat, the main crop, is grown in sequence with summer fallow.

Stubble mulching or a combination of crop-residue use and contour farming helps to limit erosion of these soils to an acceptable level. Terraces and field windbreaks also help to control erosion and to conserve moisture. If tame grasses and alfalfa are included in the cropping system, the need for erosion control measures is less. Grass cover keeps the natural drainageways from eroding.

CAPABILITY UNIT IIc-1

This unit consists of deep, nearly level silt loams and loams on uplands and stream terraces.

These soils are in good tilth. They have moderate to high water-holding capacity and are moderately permeable. The conservation of moisture is the main problem. Soil blowing and a periodic moisture deficiency are hazards. Management needs include maintaining the organic-matter content, improving fertility, preserving tilth, conserving moisture, and controlling blowing.

Wheat, oats, barley, rye, corn, sorghum, alfalfa, and tame grasses are suitable crops. Winter wheat, the main crop, is grown in sequence with summer fallow.

Crop residue helps to conserve moisture and to keep erosion to an acceptable level. Stubble mulching is beneficial if the cropping system consists of winter wheat and summer fallow. Other measures generally are not required, but stripcropping and windbreaks may be desirable in some areas.

CAPABILITY UNIT IIIe-1

This unit consists of moderately deep and deep, gently sloping to sloping silt loams and loams on uplands. In many cultivated fields these soils are slightly eroded to moderately eroded.

These soils have good tilth. They have moderate to high water-holding capacity and are moderately permeable. Management needs include control of erosion, conservation of moisture, and maintenance or improvement of fertility and tilth.

Wheat, oats, barley, rye, corn, sorghum, alfalfa, and tame grasses are suitable crops. Winter wheat, the main crop, is grown in sequence with summer fallow.

A combination of stubble mulching and contour farming or of crop-residue use and terracing helps to control erosion and conserve moisture where the cropping system consists of winter wheat and summer fallow. Crop residue can be used alone if tame grasses and legumes are grown half the time. Stripcropping, field windbreaks, and grass-covered natural drainageways also help to reduce the erosion hazard.

CAPABILITY UNIT IIIe-2

This unit consists of deep, nearly level, moderately sandy to loamy soils on uplands. Most cropped areas are slightly eroded to moderately eroded.

These soils are easy to work. They take in water readily, except where loamy, and have moderate water-holding capacity. Permeability is moderate to moderately rapid. Cultivation breaks down the structure of the surface layer and increases susceptibility to blowing. Management needs include the maintenance of organic-matter content, preservation of fertility, and conservation of moisture.

Wheat, oats, barley, rye, alfalfa, corn, sorghum, and tame grasses are suitable crops. Winter wheat is grown in some areas, but intensive management is required to control soil blowing.

Stubble mulching or a combination of crop-residue use and wind stripcropping helps to control blowing and to conserve moisture. Also beneficial are field windbreaks and a cropping system consisting of grasses and legumes.

CAPABILITY UNIT IIIe-3

This unit consists of Tuthill and Manter soils, 3 to 5 percent slopes. These are deep loams and very fine sandy loams on uplands. The subsoil is fine sandy loam or sandy clay loam. Many cultivated areas are slightly eroded to moderately eroded.

Tilth is good. The water-holding capacity is moderate, and permeability is moderate to moderately rapid. Moisture intake is somewhat limited where the surface layer is loam. Both water erosion and soil blowing are hazards. Management needs include control of erosion, conservation of moisture, and improvement of fertility.

Wheat, oats, barley, alfalfa, corn, sorghum, and tame grasses are suitable crops. Winter wheat is grown, but intensive management is required to control soil blowing where the surface layer is very fine sandy loam.

A combination of stubble mulching and contour farming or of crop-residue use and terracing helps to control erosion and conserve moisture.

CAPABILITY UNIT IIIs-1

This unit consists of nearly level silt loams and loams that are moderately deep either to hard siltstone or to gravel. The soils are on uplands and stream terraces.

These soils have moderate natural fertility and good tilth. The underlying material causes them to be droughty and limits the choice of crops. Management needs include the conservation of moisture and control of soil blowing.

Wheat, oats, barley, sorghum, and tame grasses are suitable crops. Alfalfa can be grown where the underlying material is gravel.

Crop-residue use, stubble mulching, or stripcropping helps to conserve moisture and to control erosion.

CAPABILITY UNIT IIIc-1

Kadoka silt loam, 0 to 3 percent slopes, is in this unit. It is a deep and moderately deep soil on uplands. Most areas are in parts of the county that receive the least rainfall.

This soil has moderate natural fertility and is in good tilth. The surface soil and subsoil have high water-holding capacity. The underlying material consists of bedded siltstone. Management needs include the conservation of moisture and control of soil blowing.

Wheat, oats, barley, rye, corn, sorghum, alfalfa, and tame grasses are suitable crops. Winter wheat is the main crop.

Crop-residue use alone is adequate for control of erosion and conservation of moisture. Another means is stubble mulching, which is suitable for areas used for winter wheat. Wind stripcropping helps to control blowing in large cultivated areas.

CAPABILITY UNIT IIIc-2

Haverson loam, high, 0 to 3 percent slopes, is in this unit. It is a deep, nearly level, light-colored soil on high bottoms. It is rarely flooded.

This soil is low in organic-matter content, low in natural fertility, and high in lime content. It is somewhat droughty and blows easily if used for annual crops. Management needs include the improvement of organic-matter content and fertility, conservation of moisture, and control of soil blowing.

Alfalfa is the main crop. Mainly small grain is grown under dryland farming. The acreage used for corn and sorghum is increasing under irrigated farming.

Crop-residue use and stubble mulching help to conserve moisture and to control soil blowing. The inclusion of tame grasses and alfalfa in the cropping system and the application of manure help to increase the organic-matter content and improve fertility. Commercial fertilizer can be used to advantage in irrigated areas.

CAPABILITY UNIT IIIw-1

This unit consists of nearly level, light-colored loams on bottom lands that are flooded occasionally. Most areas of these soils are in the northern part of the county.

These soils are low in organic-matter content and high in lime content. They are flooded about once every 5 years, but the benefit derived from the additional moisture ordinarily offsets minor flood damage. Annual crops are susceptible to droughtiness in dry years. Established stands of alfalfa benefit from the water table, which is at a depth of 10 to 20 feet. Management needs include conservation of moisture and improvement of fertility.

Alfalfa is the main crop, but wheat, rye, oats, barley, sorghum, and tame grasses also are suitable. Corn is grown in irrigated areas.

Crop-residue use and stubble mulching help to conserve moisture and to improve the content of organic matter. Fertility can be improved in irrigated areas by using green-manure crops, animal manure, and commercial fertilizer. Grasses and legumes are least affected by occasional flooding.

CAPABILITY UNIT IVe-1

This unit consists of Keith-Colby silt loams, 9 to 12 percent slopes. These are deep, moderately steep, silty soils on uplands. In many cultivated fields they are slightly eroded to moderately eroded.

Tilth is good. The water-holding capacity is high. Intensive practices are needed to control water erosion. Other management needs include conservation of moisture and organic matter and maintenance of fertility and tilth.

Wheat, oats, barley, rye, alfalfa, and tame grasses are suitable crops. Winter wheat is the main crop. Row crops are less suitable because of the slope.

A combination of stubble mulching, terracing, and contour farming helps to conserve moisture and to limit erosion. Grasses and legumes in the cropping system supply organic matter and help to maintain fertility and tilth. They also reduce the need for other control measures. Grass cover helps to keep the natural drainageways from eroding.

CAPABILITY UNIT IVe-2

Kadoka silt loam, 5 to 9 percent slopes, is in this unit. It is a moderately deep and deep soil on uplands. Most areas are in the northern and western parts of the county. In many cultivated fields this soil is slightly eroded to moderately eroded.

This soil is moderately fertile and is in good tilth. It has moderate to high water-holding capacity and moderate permeability. Water erosion is the main hazard. Management needs include the conservation of moisture and organic matter and maintenance of fertility and tilth.

Wheat, oats, barley, rye, sorghum, alfalfa, and tame grasses are suitable crops. Winter wheat is the main crop in most areas.

A combination of stubble mulching and contour farming or terracing helps to control erosion in intensively cropped areas. Tame grasses and legumes in the cropping system reduce the need for other control measures. The residue from these crops helps to limit erosion. Grass cover keeps the natural drainageways from eroding.

CAPABILITY UNIT IVe-3

This unit consists of deep, gently sloping, moderately sandy to loamy soils on uplands. Cultivated areas are slightly eroded to moderately eroded.

These soils take in water readily but have only moderate water-holding capacity. If cultivated, they lose organic matter rapidly and become readily susceptible to water erosion and blowing. Management needs include control of erosion, maintenance of the organic-matter content, and conservation of moisture.

Wheat, oats, barley, rye, alfalfa, corn, sorghum, and tame grasses are suitable crops. Winter wheat generally is not suitable, because of the erosion hazard.

A combination of stubble mulching, stripcropping, and contour cultivation helps to control erosion in intensively cropped areas. Field windbreaks also are beneficial. Crop-residue use alone gives adequate control of erosion if grasses and legumes are grown at least half the time.

CAPABILITY UNIT IVe-4

This unit consists of Pierre clay, 3 to 9 percent slopes, which is a moderately deep, gently sloping soil on uplands. Areas that have been cultivated may be slightly eroded to moderately eroded.

This soil is slowly permeable. It takes in water slowly and releases it slowly to plants. Tilth is only fair, the organic-matter content is low, and fertility is low to moderate. Control of water erosion and soil blowing is the main management problem. Management needs include controlling erosion, conserving moisture, increasing the organic-matter content, and improving tilth.

Wheat, oats, barley, sorghum, and tame grasses are suitable crops. Alfalfa usually does not survive during prolonged dry periods. Spring wheat is better suited than winter wheat.

A combination of stubble mulching and either contour stripcropping or terracing controls erosion and conserves moisture when the soils are cultivated continuously. Contour farming and crop-residue use alone control erosion if grasses and legumes are grown half the time. These crops help to maintain the organic-matter content and to improve tilth.

CAPABILITY UNIT IVe-5

This unit consists of gently sloping to sloping silt loams and loams that are moderately deep to hard siltstone or gravel. These soils are on uplands and stream terraces.

The soils in this unit are similar to those in unit IIIs–1 but are susceptible to water erosion. A limited root zone makes them droughty and limits the choice of crops. Management needs include control of erosion and conservation of moisture.

Wheat, oats, barley, sorghum, and tame grasses are suitable crops. Corn and alfalfa generally are not suitable.

Erosion can be controlled and moisture conserved by using a cropping system in which tame grasses are grown about half the time, and by stubble mulching and farming on the contour. Terracing is not a suitable practice for these soils.

CAPABILITY UNIT IVs–1

Kyle clay, alkali, 0 to 3 percent slopes, is in this unit. It is a deep, nearly level soil on stream terraces. Cultivated areas are slightly eroded to moderately eroded.

This soil is in poor tilth; it is very hard when dry and very firm and plastic when wet. It takes in water slowly and releases it slowly to plants. Permeability is slow. Unless the surface layer is protected by crop residue or growing plants, it is susceptible to soil blowing.

Oats, barley, sorghum, alfalfa, and tame grasses are suitable crops. Spring wheat is better suited than winter wheat, which is subject to winterkill.

Including grasses and legumes in the cropping system and utilizing the residue of annual crops help to improve tilth, conserve moisture, and control soil blowing. More intensive use requires stubble mulching or a combination of crop-residue use and wind stripcropping.

CAPABILITY UNIT IVs–2

This unit consists of deep, nearly level and gently sloping soils that have a moderately thick, silty surface layer and a claypan subsoil.

These soils have moderate natural fertility, but they take in water slowly and release it slowly to plants. The surface layer ordinarily is friable and in good tilth but has a tendency to puddle and crust in cultivated fields. The claypan slows moisture penetration and restricts root growth. Improving tilth, maintaining the organic-matter content, and loosening the claypan are the main management problems. Controlling soil blowing is a secondary problem.

Alfalfa is the main crop, but wheat, oats, barley, rye, and tame grasses also are suitable. Row crops are not suitable.

The use of crop residue and the inclusion of grasses and legumes in the cropping system help to improve tilth, to hasten the intake of moisture, and to control soil blowing. Stubble mulching is beneficial if high-residue grain crops are grown.

CAPABILITY UNIT Vw–1

Wet alluvial land is in this unit. It consists of deep, sandy to silty soils in spring-fed swales and on foot slopes and bottom lands. The water table is at or near the surface early in the growing season and usually recedes to a depth of 2 to 7 feet late in summer.

Drainage generally is not practical. Most areas are small and are used for grazing. A few of the larger areas are used for hay. Proper range use helps to maintain the cover of tall grasses. Springs, wells, and dugouts are sources of livestock water.

CAPABILITY UNIT VIe–1

This unit consists of moderately deep and deep loams and clays on uplands. These soils are too erodible for use as cropland and should be cultivated only enough to establish trees or to reestablish grass.

Most areas are in native grass and are used for grazing and hay. Proper range use helps to control erosion and to conserve moisture. Contour furrowing helps to slow runoff and restore the grass cover. Livestock water is obtained from wells, springs, dams, or dugouts. The source depends on the nature of the underlying material.

CAPABILITY UNIT VIe–2

This unit consists of deep, undulating to hilly, moderately sandy and sandy soils on uplands. These soils are not suitable for cultivation. The coarse, loamy soils are too hilly, and the sandy soils are highly susceptible to soil blowing.

Most areas are in native grass and are used for grazing and hay. Sand blowouts form easily along livestock trails and where livestock concentrate around water and salting areas. Proper range use helps to control soil blowing. Seeding to native grasses helps to stabilize areas susceptible to blowouts. Shallow wells provide livestock water in most areas.

CAPABILITY UNIT VIw–1

Alluvial land is in this unit. It is on bottom lands and is subject to damaging floods. Many of the bottom lands are narrow and have been cut into small parcels by meandering streams. Deposition and streambank erosion are the main hazards.

Most areas are in native grass and are used for grazing and hay. In many areas there are clumps of native trees and shrubs, which provide protection for livestock and game animals in winter. Small areas are used as garden plots. Proper range use helps to retard runoff and to limit flood damage. Water-retarding and grade-stabilizing structures help to control floods in some areas.

CAPABILITY UNIT VIs–1

This unit consists of moderately alkaline to strongly alkaline claypan soils. These soils have a thin surface layer and a very hard and very firm subsoil.

Tilth is poor, and the natural fertility generally is low. Permeability is very slow. Water ponds in some areas, and all areas dry out slowly in spring. Maintaining a vegetative cover is the main management problem.

Most areas are in native grass and are used for grazing. Some are used for hay, and a few are cultivated. Proper range use helps to maintain the grass cover. Interseeding with suitable grasses helps to improve pasture. Cultivated areas should be seeded to native grass.

CAPABILITY UNIT VIs–2

This unit consists of shallow, gently sloping to moderately steep, loamy to clayey soils on uplands. Erosion is a hazard if the vegetative cover is disturbed.

Management needs include control of erosion and conservation of moisture. Proper range use meets these needs

in areas of native grass. Contour furrowing and range seeding are practical on most slopes. Cultivated areas should be seeded to native grass. Stockwater impoundments are the only source of livestock water in areas of the clayey soils. Wells and springs are sources in areas of the loamy soils.

CAPABILITY UNIT VIIs-1

Swanboy clay, the only soil in this unit, is strongly alkaline and dense. It has a very thin, crusty surface layer and an extremely hard subsoil.

This soil has poor tilth and is low in natural fertility. It is very slowly permeable. All areas are used for grazing. Proper range use that protects the sparse grass cover is the main management need.

CAPABILITY UNIT VIIs-2

This unit consists of shallow, hilly soils on uplands. Management needs include maintenance of the plant cover and control of erosion. Proper range use is the only practical measure. Grazing should be deferred where the range condition is poor or fair. The irregular slopes make mechanical measures impracticable. Deep ravines in some areas provide food and protection for game animals.

CAPABILITY UNIT VIIIs-1

In this unit are Barren badlands and outcrops of sandstone, siltstone, and shale. There is little or no vegetation. The areas are useful mainly for scenery and for recreation, which includes searching for agates, artifacts, and fossils.

Yield Predictions

Table 2 lists, for each soil in the county judged suitable for crops, the predicted average yields per acre of winter wheat, barley, oats, corn, and alfalfa. The predictions are for dryfarmed soils under two levels of management. Predictions of yields of irrigated crops are not available. The irrigated acreage is small and is mostly in alfalfa. The yield from two cuttings is about 2.5 tons per acre. It can be increased if enough water is applied and a high level of management is practiced.

The yield predictions shown in columns A of table 2 are those that can be expected under management that is customarily practiced in this county. For example, (1) winter wheat is followed by summer fallow; (2) spring-sown small grain, corn, and sorghum are grown as feed for livestock; (3) alfalfa and tame grasses generally remain in a field until the stand either fails or becomes unproductive; (4) crop residue is used, but not in sufficient quantity; (5) weeds are controlled, but the number of tillage operations required causes the soil structure to deteriorate and a tillage pan to form; (6) most fallow fields are left bare in summer and until winter wheat is seeded; (7) uncontrolled water erosion and soil blowing cause soil losses in some years; and (8) commercial fertilizer, barnyard manure, and green-manure crops generally are not used.

The predicted yields shown in columns B are those that can be expected under improved management, which includes (1) using a cropping system that supplies organic matter and helps to maintain fertility and tilth; (2) keeping erosion to a minimum and conserving moisture by using a combination of practices; (3) adding commercial fertilizer in amounts indicated by soil tests and field trials; (4) tilling at the right time and only enough to control weeds; and (5) planting adapted crop varieties.

The yield predictions in table 2 were based on results of field trials made in adjacent Bennett County by the South Dakota State University, on information furnished by farmers, on records kept by the Agricultural Stabilization and Conservation Service, and on observations by agriculturists of State and Federal agencies. These predictions were then compared with those of the South Dakota Crop and Livestock Reporting Service (*9*).

The period of records and tests was 1950–65. During this period there were years when the supply of moisture was good and years when the supply was limited. Yields from the same kind of soil can differ from one field to another, depending on management.

Use of the Soils for Windbreaks [5]

Sparse stands of ponderosa pine and cedar are scattered in the hilly parts of Washabaugh County (fig. 9). Cottonwood and other broadleaf trees grow along the main streams. Chokecherry, plum, juneberry, woods rose, and other shrubs are both on stream bottoms and along ravines in the hilly areas. Some of the native trees are cut for firewood and fenceposts. Very few are used for rough lumber, because they have many limbs and are crooked and in poor condition. All of the native trees and shrubs help to provide food and cover for livestock and wildlife.

The main reason for planting trees in Washabaugh County is to establish farmstead or field windbreaks. Some trees grow around most farmsteads and ranch headquarters, but supplemental planting generally is needed to make a windbreak that will effectively protect livestock, fruit trees, and gardens and keep snow from drift-

Figure 9.—**Ponderosa pine in an area of Epping-Rock outcrop complex.**

[5] By ELMER L. WORTHINGTON, woodland conservationist, Soil Conservation Service.

TABLE 2.—*Predicted average acre yields of principal dryfarmed crops under two levels of management*

[Yields in columns A are those to be expected under management commonly practiced; yields in columns B are those to be expected under improved management. Only soils suitable for crops are listed. Absence of yield figure indicates that crop is not commonly grown on the soil]

Soil	Winter wheat		Barley		Oats		Corn		Alfalfa	
	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*
Altvan loam, 0 to 3 percent slopes	23	27	17	22	19	27	13	16	0.7	0.9
Altvan loam, 3 to 9 percent slopes	20	24	15	20	17	23	------	------	.5	.6
Goshen silt loam, 0 to 3 percent slopes	33	40	28	35	36	43	24	32	1.6	2.0
Haverson loam, high, 0 to 3 percent slopes	14	18	11	15	14	18	------	------	.9	1.4
Haverson loam, low, 0 to 3 percent slopes	17	25	15	19	20	29	18	26	1.2	2.0
Haverson silty clay loam, 0 to 3 percent slopes	20	29	15	19	21	30	17	25	1.3	2.0
Huggins silt loam, 0 to 3 percent slopes	17	21	17	21	20	27	------	------	.7	.9
Kadoka silt loam, 0 to 3 percent slopes	27	32	22	27	27	33	18	26	1.0	1.3
Kadoka silt loam, 3 to 5 percent slopes	26	31	21	26	26	32	17	25	.9	1.2
Kadoka silt loam, 5 to 9 percent slopes	22	26	17	21	22	27	------	------	.7	1.0
Kadoka-Huggins complex, 3 to 9 percent slopes:										
Kadoka soil	24	29	19	24	24	29	16	19	.8	1.0
Huggins soil	15	18	15	18	18	22	------	------	.4	.5
Keith silt loam, 0 to 3 percent slopes	33	39	25	31	33	42	20	28	1.3	1.6
Keith silt loam, 3 to 5 percent slopes	31	37	24	30	30	39	18	26	1.2	1.5
Keith-Colby silt loams, 9 to 12 percent slopes:										
Keith soil	25	30	18	22	22	30	------	------	.9	1.1
Colby soil	16	22	14	18	16	22	------	------	.7	.9
Keith-Rosebud silt loams, 3 to 5 percent slopes:										
Keith soil	31	37	24	30	30	39	18	26	1.2	1.5
Rosebud soil	27	32	22	26	28	34	17	25	1.0	1.3
Keith-Rosebud-Canyon complex, 5 to 9 percent slopes:										
Keith soil	28	34	22	28	26	35	16	21	1.1	1.4
Rosebud soil	25	30	20	25	25	30	15	19	.9	1.1
Canyon soil	------	------	------	------	------	------	------	------	------	------
Keith and Ulysses silt loams, 5 to 9 percent slopes:										
Keith soil	28	34	22	28	26	35	16	20	1.1	1.4
Ulysses soil	26	32	21	26	25	31	15	20	.9	1.1
Pierre clay, 3 to 9 percent slopes	14	19	14	19	15	23	------	------	.7	1.0
Richfield and Keith silt loams, 0 to 3 percent slopes:										
Richfield soil	31	37	24	30	32	40	19	26	1.2	1.5
Keith soil	33	39	25	31	33	42	20	28	1.3	1.6
Richfield and Keith silt loams, 3 to 9 percent slopes:										
Richfield soil	30	36	23	28	30	39	18	25	1.1	1.4
Keith soil	29	35	23	29	28	37	17	23	1.1	1.4
Tuthill and Anselmo fine sandy loams, 0 to 3 percent slopes:										
Tuthill soil	22	28	18	24	26	33	22	28	1.0	1.3
Anselmo soil	20	25	16	19	18	25	20	26	.9	1.2
Tuthill and Anselmo fine sandy loams, 3 to 9 percent slopes:										
Tuthill soil	20	26	16	20	22	30	20	26	.9	1.2
Anselmo soil	17	22	14	18	16	24	18	24	.8	1.1
Tuthill and Manter soils, 0 to 3 percent slopes:										
Tuthill soils	24	30	20	26	27	35	23	29	1.0	1.3
Manter soils	21	26	17	22	22	30	20	24	1.0	1.3
Tuthill and Manter soils, 3 to 5 percent slopes:										
Tuthill soils	23	29	19	25	25	32	22	28	1.0	1.3
Manter soils	20	25	16	21	21	28	19	24	.9	1.2
Tuthill and Manter soils, 5 to 9 percent slopes:										
Tuthill soils	19	25	17	22	21	28	18	24	.9	1.1
Manter soils	17	22	14	18	18	25	17	22	.8	1.0
Wortman-Wanblee complex:										
Wortman soil	11	14	14	17	16	20	------	------	.7	.9
Wanblee soil	------	------	------	------	------	------	------	------	------	------

ing into yards (fig. 10). Field windbreaks are for the purpose of protecting cropland from the wind and holding snow on the fields. One-row field windbreaks generally are adequate for Kadoka, Keith, Richfield, and Rosebud soil. Wider windbreaks are needed for Anselmo, Manter, and Tuthill soils.

Windbreak planting sites need careful preparation, and the trees planted need to be protected from fire, insects, disease, and excessive grazing. Information about the establishment and care of trees can be obtained from the local office of the Soil Conservation Service or the Bureau of Indian Affairs.

Some species of trees and shrubs grow well only on certain soils, a few grow well on many of the soils, and some do not grow well on any. The soils in Washabaugh County that are suitable for tree plantings are placed in seven

Figure 10.—A 5-year-old farmstead windbreak in an area of Tuthill soils.

windbreak groups, which are described in the following paragraphs. The names of the soil series represented are mentioned in the description of each group, but this does not mean that all the soils of a given series are in the group. To find the windbreak group of any given mapping unit, refer to the "Guide to Mapping Units."

Windbreak group 1

In this group are deep, loamy soils of the Anselmo, Tuthill, and Manter series. These soils are on uplands. They take in water readily and release it readily to tree roots. In some places the water table occurs at a depth of 10 to 30 feet. Soil blowing is a hazard. Stubble or vegetation should be left between the rows of trees to control blowing, and cultivation should be confined to the tree rows.

These soils are good for windbreaks. Suitable broadleaf trees are American elm, Siberian elm, Chinkota elm, green ash, hackberry, and honeylocust. American elm and hackberry should be used sparingly because the soils tend to be droughty. Suitable conifers are eastern redcedar, Rocky Mountain redcedar, and ponderosa pine. Suitable shrubs are American plum, buffaloberry, caragana, chokecherry, common lilac, honeysuckle, Nanking cherry, Russian-olive, sand cherry, and three-leaf sumac.

Windbreak group 2

This group consists of deep and moderately deep, well drained and moderately well drained, silty and loamy soils. It is made up of Loamy land and soils of the Altvan, Colby, Goshen, Haverson, Huggins, Kadoka, Keith, Oglala, Richfield, Rosebud, and Ulysses series. These soils have moderately slow to moderately rapid permeability. In most areas of Haverson soils, the depth to the water table is about 20 feet. Most areas depend on precipitation for moisture, but Haverson soils occasionally receive extra water from floods and Goshen soils receive runoff from higher areas. Contour cultivation and terraces help to conserve moisture and control erosion in sloping areas. Clean cultivation helps to eliminate weeds, which compete with the trees for moisture.

These soils are good for windbreaks. Suitable trees are American elm, Chinkota elm, green ash, hackberry, honeylocust, eastern redcedar, Rocky Mountain redcedar, ponderosa pine, and spruce, either Black Hills spruce or Colorado blue spruce. American elm and hackberry trees should be used sparingly, because they lack resistance to drought, and spruce trees require special management. Suitable shrubs are American plum, buffaloberry, caragana, chokecherry, common lilac, honeysuckle, Nanking cherry, Russian-olive, sand cherry, and three-leaf sumac.

Windbreak group 3

In this group are Clayey land and deep and moderately deep, clayey soils of the Pierre series. These soils are on uplands and stream terraces. They are underlain in some places by clay shale. Permeability is slow, the intake rate is slow, and water is released slowly to tree roots. Clean cultivation and careful management are needed for effective windbreaks. On sloping sites, contour plantings and terraces help to conserve moisture and stimulate tree growth.

Suitable trees are Siberian elm, Chinkota elm, green ash, eastern redcedar, Rocky Mountain redcedar, and ponderosa pine. Suitable shrubs are buffaloberry, caragana, chokecherry, common lilac, American plum, sand cherry, and three-leaf sumac.

Windbreak group 4

In this group are somewhat poorly drained to poorly drained, sandy to clayey Alluvial land and Wet alluvial land. These land types are on bottom lands and on subirrigated foot slopes and drainageways on uplands. The areas on bottom lands are flooded occasionally. The depth to the water table generally is at least 10 feet in areas of Alluvial land and ranges from 2 to 7 feet in areas of Wet alluvial land.

Cottonwood, golden willow, and white willow are suitable for windbreaks on both of these land types. Siberian elm, green ash, and eastern redcedar also are suitable for use on Alluvial land.

Windbreak group 5

In this group are deep soils of the Mosher and Wortman series. These soils have a moderately thick surface layer of friable silt loam and a very hard and very firm claypan. The claypan restricts the movement of water and affects the root development of young trees.

Suitable trees for windbreaks are Siberian elm, Chinkota elm, green ash, eastern redcedar, Rocky Mountain redcedar, and ponderosa pine. Suitable shrubs are buffaloberry, caragana, common lilac, and three-leaf sumac.

Windbreak group 6

In this group are saline-alkali soils of the Minatare series. These soils usually are moderately wet because the water table is high. Permeability is very slow. Salts generally occur in the uppermost 12 inches.

Suitable for windbreaks are cottonwood, diamond willow, and purple willow. Siberian elm, Chinkota elm, green ash, and honeylocust have some chance of success on the drier sites. Suitable shrubs are buffaloberry, Russian-olive, and three-leaf sumac.

Windbreak group 7

In this group are deep, light-colored, loose, sandy soils of the Valentine series. These soils are on uplands. Water enters the soil easily and passes rapidly through it to the water table, which occurs at a depth of 20 feet or more in most places. These soils blow easily and ordinarily should not be disturbed. If windbreaks are needed to protect winter feedlots and ranch headquarters, the trees should be planted in shallow furrows and should not be cultivated.

Suitable trees for windbreaks are eastern redcedar, Rocky Mountain redcedar, and ponderosa pine. Siberian elm, green ash, Russian-olive, American plum, and common lilac will grow under intensive care.

Wildlife [6]

Common kinds of wildlife in Washabaugh County are deer, antelope, coyotes, pheasants, and prairie grouse. Less important but also common are waterfowl, skunks, raccoons, badgers, rabbits, prairie dogs, snakes, and numerous species of songbirds.

In this section wildlife is discussed in relation to the eight soil associations that are shown on the general soil map at the back of the survey and described in the section "General Soil Map."

Additional information about the development or improvement of wildlife habitat can be obtained from representatives of the Soil Conservation Service; the South Dakota Department of Game, Fish, and Parks; and the Bureau of Indian Affairs.

Deer.—The deer population has increased in recent years. Small numbers of both white-tailed deer and mule deer occur throughout most parts of the county. The heaviest concentration is in the Oglala-Canyon-Keith association, where brushy draws are common.

Prairie grouse.—Sharp-tailed grouse, which are the most common, and pinnated grouse, or prairie chickens, occur in all the associations except the Badlands association. There are large populations of these gamebirds in the Tuthill-Keith-Richfield association and moderately large populations in the Kadoka-Epping and the Oglala-Canyon-Keith associations. The number of grouse varies according to the density and height of the grass cover.

Pheasants.—This county supports only a moderate population of pheasants. These birds are mainly in the Tuthill-Keith-Richfield association and in the eastern part of the Oglala-Canyon-Keith association. These associations have enough cropland to provide habitat favorable for propagation.

Waterfowl.—Ducks are fairly common throughout the county. The present population of blue-winged teal, mallards, and pintails is 10 to 12 breeding ducks per square mile. These birds find few naturally wet areas but are attracted to livestock watering developments. The construction of more dams and dugouts usually results in an increase in the number of ducks.

Furbearers.—Small populations of jackrabbits, cottontails, raccoons, skunks, and badgers inhabit farming areas of the Tuthill-Keith-Richfield and the Oglala-Canyon-Keith associations. A few muskrats and minks live in the associations along the White River.

Fish.—Natural habitat for fish is almost nonexistent in this county. The White River is not a good habitat, because of the high silt content and wide fluctuations in the water level. Some farm ponds have been stocked with bass and bluegills, and deeper, colder ponds have been stocked with trout.

Engineering Uses of the Soils [7]

This section provides information of special interest to engineers, contractors, farmers, and others who use soil as structural material or as foundation material upon which structures are built. In this section are discussed properties of the soils that affect construction and maintenance of roads and airports, building foundations, pipelines, water-storage facilities, erosion-control structures, drainage systems, irrigation systems, and sewage-disposal systems. Among the soil properties most important in engineering are permeability, shear strength, density, shrink-swell potential, water-holding capacity, grain-size distribution, plasticity, and reaction. Information concerning these and related soil properties is furnished in four tables.

The estimates and interpretations of soil properties in this section can be used to —

1. Make preliminary estimates of engineering properties of the soils for the purpose of determining the feasibility for and the planning of farm ponds, irrigation systems, waterspreading systems, diversions, terraces, and other earthen structures.
2. Make preliminary evaluations of soil conditions that will aid in selecting locations for highways and airports, pipelines, and cables, and in planning detailed investigations at the selected locations.
3. Locate probable sources of sand, gravel, clay, or rock suitable for use as construction material.
4. Aid in the selection of industrial, business, residential and recreational sites.
5. Supplement information obtained from other published maps and reports and aerial photographs, for the purpose of making soil maps and reports that engineers can use readily.

With the use of the soil map for identification, the engineering interpretations in this section can be useful for many purposes. It should be emphasized that they do not eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads and ex-

[6] By LEROY A. SHEARER, biologist, Soil Conservation Service.

[7] By ODELL A. ALDRICH, agricultural engineer, Soil Conservation Service.

cavations deeper than the depths of layers here reported. Even in these situations, the soil map is useful in planning more detailed field investigations and for suggesting the kinds of problems that may be expected.

Engineering classification systems

The engineering systems now most widely used to classify soils are the Unified system (*12*) and the system developed by the American Association of State Highway Officials (AASHO) (*2*).

The Unified soil classification system was established by the Waterways Experiment Station, Corps of Engineers. This system is based on the identification of soils according to particle-size distribution, plasticity, and liquid limit. In this system SW and SP are symbols for clean sands; SM and SC for sands with nonplastic or plastic fines (G replaces S if the major coarse fraction is gravel); ML and CL for nonplastic or plastic, fine-grained materials of low liquid limit; and MH and CH for nonplastic or plastic, fine-grained materials of high liquid limit. Some soils are on the borderline between two of these groups and are given a dual classification, for example, SM–SC or ML–CL.

The system developed by the American Association of State Highway Officials is based on the performance of soils in highways. It groups soils of about the same general load-carrying capacity and service. All materials are classified in seven basic groups, A–1 through A–7. The best soils for road subgrade are classified as A–1; the poorest are classified as A–7.

Agricultural scientists classify soils by using the textural classification of the U.S. Department of Agriculture. In this system the classification is determined mainly by the percentage of soil particles smaller than 2 millimeters in diameter, or the percentage of sand, silt, and clay.

Estimated properties of the soils

Table 3 lists the soil series and mapping units in Washabaugh County and gives estimates of some of the soil properties that affect engineering work. These estimates are based on test data shown in table 5 and on knowledge of the soils gained during the course of the soil survey. A more complete description of each soil can be found in the section "Descriptions of the Soils."

The percentage of material passing the number 10, 40, and 200 sieves reflects the normal range for a specified soil. Most soils fall within the range listed in table 3, but it should not be assumed that all of them do.

Permeability relates only to the movement of water downward through an undisturbed soil. The estimates are based on soil structure and texture.

Available water capacity is the capacity of a soil to hold water in a form available to plants after the free water has drained out.

Reaction, which indicates the degree of acidity or alkalinity of a soil, is expressed as a pH value. The determinations were made by using a glass electrode or color-indicator tests.

The shrink-swell potential is an indication of the volume change to be expected of the soil material with changes in moisture content.

Interpretations of engineering properties

Table 4 gives the suitability of the soils for certain uses and shows specific characteristics that affect the design and construction of highways and structures.

The suitability of a soil material for topsoil depends largely on thickness, texture, organic-matter content, and natural fertility. Eroded soils, for example, generally are not thick enough, and clayey soils tend to be difficult to work.

No estimates are shown in table 4 for suitability of the soils in the county as a source of gravel and sand, or for drainage structures, irrigation structures, or waterways. Sand and gravel suitable for construction purposes generally are not available in this county. Drainage is only a minor problem. Wet areas of Hoven soils, for example, can be drained by open ditches if suitable outlets are present, or the water can be diverted by terracing the adjacent slopes. Only a small acreage along the White River is irrigated. Most of the waterways in the county are constructed on Goshen, Kadoka, Keith, Richfield, and Rosebud soils. Care should be taken in reshaping waterways, since the soils are susceptible to water erosion until vegetation is well established.

Engineers and others should not apply specific values to the estimates of bearing capacity given in the last column of table 4, which shows limitations of the soils as foundation material for low buildings.

Engineering test data

Table 5 (p. 54) presents data obtained by laboratory tests on samples from five soil profiles. The tests were performed by the South Dakota Department of Highways in cooperation with the U.S. Bureau of Public Roads. They were conducted in accordance with standard procedures of the American Association of State Highway Officials. Some of the terms used in table 5 are explained in the following paragraphs.

If a soil material is compacted at successively higher moisture content, assuming that the compactive effort remains constant, the density of the compacted material will increase until the optimum moisture content is reached. After that, the density decreases as the moisture content increases. The highest dry density obtained in the compaction test is termed *maximum dry density*, and the corresponding moisture content is the *optimum moisture*. Moisture-density data are important in earthwork, for, as a rule, soil is most stable if it is compacted to about the maximum dry density at approximately the optimum moisture content.

In mechanical analysis, the soil components are sorted by particle size. Sand and other granular material are retained on a No. 200 sieve, but finer particles pass through the openings. Clay is the fraction smaller than 0.002 millimeter in diameter. The material intermediate in size between that held on the No. 200 sieve and that having a diameter of 0.002 millimeter is mostly silt.

TABLE 3.—*Estimated*

[Estimates are not shown for the miscellaneous

Soil series and map symbols	Depth from surface	Classification		
		USDA texture	Unified	AASHO
	In.			
Altvan (AlA, AlC).	0–8	Loam to silt loam	ML, ML–CL	A–4 to A–6
	8–26	Silty clay loam to sandy clay loam	CL, SC	A–6 to A–7
	26–40	Stratified gravelly sandy loam to gravel.	SM, GM–GP	A–2, A–1, A–4
Anselmo (AvD). For properties of Valentine soil, refer to Valentine series in this table.	0–20	Sandy loam	SM	A–2 to A–4
	20–36	Loamy sand to sandy loam	SM, SM–SC	A–2, A–4
	36–60	Loamy sand to sand	SM, SP–SM	A–2 to A–4
Canyon (CaF, Cc).	0–16	Loam	ML	A–4
	16+	Sandstone.		
Colby.	0–60	Silt loam	ML, ML–CL	A–4 to A–6
Epping (EhF, EkE, Er). For properties of Kadoka soil in EkE, refer to Kadoka series in this table.	0–24	Silt loam	ML, ML–CL	A–4 to A–7
	24+	Siltstone.		
Goshen (GoA).	0–21	Silt loam	ML to CL	A–4 to A–6
	21–45	Silty clay loam	CL, CH	A–6 to A–7
	45–60	Silt loam	ML to CL	A–4 to A–6
Haverson:				
Loam (HhA, HlA).	0–60	Stratified loam, silt loam, and very fine sandy loam.	ML, ML–CL, SM	A–4
Silty clay loam (HoA).	0–20	Silty clay loam to silt loam	CL, ML–CL	A–6 to A–7
	20–60	Stratified silty clay to very fine sand.	CH to SM	A–7 to A–4
Hisle (Hs).	0–9	Clay	CH	A–7
	9+	Shale.[1]		
Hoven (Hv).	0–36	Silty clay [2]	CH, MH	A–7
	36–60	Silty clay to sandy loam	CH to SM	A–6 to A–7
Huggins (HwA).	0–7	Silt loam	ML, ML–CL	A–6 to A–4
	7–15	Clay	CH	A–7
	15–25	Silty clay loam	CL, CH	A–6 to A–7
	25+	Siltstone.		
Kadoka (KaA, KaB, KaC, KbC, KdC). For properties of Epping soil in KbC and for Huggins soil in KdC, refer to those series in this table.	0–4	Silt loam	ML, ML–CL	A–6 to A–7
	4–22	Silty clay loam to silt loam	CL, ML–CL	A–7 to A–4
	22–34	Silt loam	ML–CL, ML	A–4 to A–6
	34+	Siltstone.		
Keith (KeA, KeB, KhD, KhE, KrB, KsC, KuC). For properties of Colby soil in KhD and KhE; for Rosebud soil in KrB and KsC; for Canyon soil in KsC; and for Ulysses soil in KuC, refer to those series in this table.	0–6	Silt loam	ML, ML–CL	A–4 to A–7
	6–19	Silty clay loam	CL, ML–CL	A–7 to A–6
	19–55	Silt loam	ML–CL, ML	A–7 to A–6
Kyle (KyA).	0–32	Silty clay to clay [3]	CH	A–7
	32–60	Silty clay to silty clay loam	CH to CL	A–7
Manter.	0–9	Sandy loam to loam	SM, ML	A–4
	9–24	Sandy loam	SM, ML	A–4 to A–2
	24–60	Sandy loam to sand	SM	A–4 to A–2
Minatare.	0–13	Clay loam [1]	CL to CH	A–7
	13–60	Loam to very fine sandy loam	CL to ML	A–4 or A–6

See footnotes at end of table.

properties of the soils

land types, for example, Alluvial land]

Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential
No. 10	No. 40	No. 200				
			In./hr.	*In./in. of soil*	*pH*	
95–100	95–100	65–85	0. 80– 2. 00	0. 17–0. 19	6. 6–7. 3	Low.
85–100	85–100	45–75	0. 20– 0. 80	0. 14–0. 21	7. 4–7. 8	Moderate.
40–60	20–60	10–40	5. 00–10. 00	0. 03–0. 10	7. 4–8. 4	Low.
100	70–95	25–40	2. 50– 5. 00	0. 10–0. 15	6. 6–7. 3	Low.
100	50–95	15–40	2. 50–10. 00	0. 06–0. 15	6. 6–7. 3	Low.
95–100	40–80	10–35	5. 00–10. 00	0. 03–0. 10	7. 4–8. 4	Low.
90–100	60–90	50–80	1. 20– 2. 50	0. 17–0. 19	7. 4–8. 4	Low.
---------------	100	80–100	0. 80– 2. 00	0. 13–0. 19	7. 4–8. 4	Low.
90–100	80–100	75–95	0. 80– 2. 00	0. 17–0. 19	7. 4–8. 4	Low.
100	95–100	85–100	0. 80– 2. 00	0. 17–0. 19	6. 6–7. 3	Moderate.
100	95–100	85–100	0. 20– 0. 80	0. 14–0. 21	6. 6–7. 8	Moderate to high.
95–100	95–100	70–100	0. 80– 2. 00	0. 17–0. 21	7. 9–8. 4	Low to moderate.
100	80–100	40–80	0. 80– 2. 50	0. 10–0. 19	7. 9–8. 4	Low.
100	95–100	85–100	0. 20– 0. 80	0. 14–0. 21	7. 9–8. 4	Moderate.
90–100	75–100	40–95	0. 20– 3. 00	0. 10–0. 21	7. 9–8. 4	High to low.
90–100	90–100	90–100	<0. 05	0. 13–0. 21	8. 5–9. 0	High.
---------------	100	90–100	0. 05– 0. 20	0. 13–0. 21	7. 4–9. 0	High.
95–100	70–100	40–90	0. 05– 2. 50	0. 10–0. 21	7. 9–9. 0	High to low.
---------------	100	85–100	0. 80–2. 00	0. 17–0. 19	6. 6–7. 3	Moderate.
95–100	95–100	85–100	0. 05–0. 20	0. 13–0. 21	7. 4–7. 8	High.
85–100	80–100	75–100	0. 20–0. 80	0. 14–0. 21	7. 4–7. 8	Moderate to high.
95–100	95–100	80–100	0. 80–2. 00	0. 17–0. 19	6. 6–7. 3	Moderate
95–100	95–100	80–100	0. 20–2. 00	0. 14–0. 21	7. 4–8. 4	Moderate.
80–100	80–100	75–95	0. 80–2. 00	0. 17–0. 19	7. 9–9. 0	Moderate.
---------------	100	85–100	0. 80–2. 00	0. 17–0. 19	6. 6–7. 3	Low.
---------------	100	85–100	0. 20–0. 80	0. 14–0. 21	6. 6–7. 8	Moderate.
---------------	100	60–95	0. 80–2. 00	0. 17–0. 19	7. 9–8. 4	Moderate to low.
---------------	100	90–100	0. 05–0. 20	0. 13–0. 21	7. 4–8. 4	High.
90–100	90–100	80–100	0. 05–0. 80	0. 13–0. 21	7. 9–8. 4	High to moderate.
100	80–95	30–60	1. 20–5. 00	0. 10–0. 19	6. 6–7. 3	Low.
100	90–100	30–45	2. 50–5. 00	0. 10–0. 15	7. 4–7. 8	Low.
90–100	50–80	15–35	2. 50–10. 00	0. 03–0. 10	7. 9–8. 4	Low.
---------------	100	60–85	<0. 05	0. 14–0. 21	8. 0–9. 0	High.
90–100	90–100	50–80	0. 05–0. 80	0. 13–0. 17	8. 5–9. 5	Moderate.

TABLE 3.—*Estimated properties*

Soil series and map symbols	Depth from surface	Classification		
		USDA texture	Unified	AASHO
	In.			
Mosher (Mm). For properties of Minatare soil, refer to Minatare series in this table.	0–10	Silt loam to very fine sandy loam	ML, ML–CL	A–4
	10–24	Clay to clay loam [1]	CH	A–7
	24–60	Clay to loamy sand	CH to SM	A–7 to A–2
Oglala (OcE). For properties of Canyon soil, refer to Canyon series in this table.	0–36	Silt loam to very fine sandy loam	ML	A–4
	36+	Sandstone.		
Pierre (PeC, PsE). For properties of Samsil soil in PsE, refer to Samsil series in this table.	0–35	Clay to silty clay	CH	A–7
	35+	Shale.		
Richfield (RkA, RkC). For properties of Keith soil, refer to Keith series in this table.	0–10	Silt loam	ML–CL, ML	A–6 to A–2
	10–31	Silty clay loam	CL, ML–CL	A–7, A–6
	31–60	Silt loam (sand and gravel below depth of 40 inches in northern part of the county.)	ML, CL	A–4 to A–6
Rosebud.	0–8	Loam to silt loam	ML	A–4
	8–22	Clay loam to loam	CL, ML–CL	A–6
	22–36	Loam to sandy loam	ML, SM	A–4
	36+	Bedded sandstone.		
Samsil (SpE, Ss). For properties of Pierre soil in SpE, refer to Pierre series in this table.	0–15	Silty clay to clay	CH, MH	A–7
	15+	Shale.		
Swanboy (Sw).	0–23	Clay [4]	CH	A–7
	23–60	Clay to silty clay loam	CH, CL	A–7 to A–6
Tuthill (TnA, TnC, TuA, TuB, TuC). For properties of Anselmo soil in TnA, and TnC and for Manter soil in TuA, TuB, and TuC, refer to those series in this table.	0–12	Fine sandy loam to loam	SM, ML	A–4
	12–38	Sandy clay loam to clay loam	SC, CL	A–6 to A–4
	38–60	Sandy loam to sand (gravelly locally).	SM	A–2 to A–4
Ulysses.	0–13	Silt loam	ML, ML–CL	A–4 to A–6
	13–60	Silt loam to very fine sandy loam	ML	A–4
Valentine (Vs).	0–60	Loamy sand to sand	SM, SP–SM	A–2
Wanblee (Wa).	0–10	Clay loam to silty clay [1]	CL, CH	A–7
	10–41	Silt loam	ML–CL, CL	A–6
	41+	Bedded siltstone.		
Wortman (Ww). For properties of Wanblee soil, refer to Wanblee series in this table.	0–8	Silt loam	ML–CL, ML	A–4
	8–23	Silty clay to clay loam [2]	CL, ML–CL	A–7
	23–50	Silt loam	ML–CL, ML	A–4
	50+	Soft bedded siltstone.		

[1] High dispersion, saline.
[2] High dispersion.
[3] Moderate dispersion.
[4] Moderate dispersion, saline.

of the soils—Continued

Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential
No. 10	No. 40	No. 200				
			In./hr.	*In./in. of soil*	*pH*	
----------------	100	60–80	0. 80–2. 00	0. 13–0. 19	6. 6–7. 3	Moderate.
----------------	100	70–95	0. 05–0. 20	0. 13–0. 21	7. 9–9. 0	High.
90–100	90–100	30–80	0. 05–5. 00	0. 06–0. 21	7. 9–9. 0	High to low.
90–100	90–100	60–90	0. 80–2. 00	0. 13–0. 19	6. 6–7. 8	Low.
95–100	95–100	90–100	0. 05–0. 20	0. 13–0. 21	7. 4–8. 4	High.
100	95–100	65–90	0. 80–2. 00	0. 17–0. 19	6. 6–7. 3	Low.
100	95–100	80–95	0. 20–0. 80	0. 14–0. 21	7. 4–7. 8	Moderate to high.
90–100	90–100	70–90	0. 80–2. 00	0. 17–0. 19	7. 4–8. 4	Low to moderate.
95–100	95–100	60–90	0. 80–2. 50	0. 17–0. 19	6. 6–7. 3	Low.
95–100	95–100	60–75	0. 20–0. 80	0. 14–0. 21	7. 4–8. 4	Moderate.
90–100	70–95	35–65	1. 20–3. 00	0. 10–0. 19	7. 9–8. 4	Low.
95–100	95–100	85–100	0. 05–0. 20	0. 13–0. 21	7. 9–8. 4	High to moderate.
95–100	95–100	90–100	<0. 05	0. 13–0. 21	7. 9–9. 0	High.
90–100	90–100	85–100	0. 05–0. 20	0. 13–0. 21	7. 9–9. 0	High.
100	90–100	40–70	1. 20–3. 00	0. 10–0. 19	6. 6–7. 3	Low.
95–100	90–100	40–80	0. 20–2. 00	0. 14–0. 21	6. 6–7. 8	Low.
85–100	65–90	15–40	2. 50–10. 00	0. 03–0. 15	7. 4–8. 4	Low.
----------------	100	85–100	0. 80–2. 00	0. 17–0. 19	6. 6–8. 4	Moderate to low.
----------------	100	60–90	0. 80–3. 00	0. 13–0. 19	7. 9–8. 4	Low.
90–100	50–80	0–25	5. 00–10. 00	0. 03–0. 10	6. 6–8. 4	Low.
----------------	100	90–100	<0. 05	0. 13–0. 21	7. 9–9. 0	High.
90–100	90–100	70–90	0. 20–0. 80	0. 17–0. 21	7. 9–9. 0	Moderate to low.
100	90–100	80–100	0. 80–2. 00	0. 17–0. 19	6. 6–7. 3	Low.
100	90–100	85–100	0. 05–0. 20	0. 13–0. 21	7. 4–9. 0	High.
90–100	90–100	70–95	0. 80–2. 00	0. 17–0. 19	7. 9–9. 0	Low.

TABLE 4.—*Interpretations of*

Soil series and map symbols	Suitability as a source of—		Soil limitations for sewage disposal	
	Topsoil	Road fill	Septic tank filter fields	Lagoons
Altvan (AlA, AlC)	Good	Good to fair	Slight	Severe: rapid permeability in substratum.
Anselmo (AvD). For properties of Valentine soil, refer to Valentine series in this table.	Fair: blows easily	Good	Slight	Severe: rapid permeability in substratum.
Canyon (CaF, Cc)	Poor: thin	Fair	Severe to moderate: 5 to 40 percent slopes.	Severe: 5 to 40 percent slopes.
Colby	Fair if fertilized: high in lime content.	Fair to poor	Severe to moderate: 9 to 25 percent slopes.	Severe to moderate: 9 to 25 percent slopes.
Epping (EhF, EkE, Er). For properties of Kadoka soil in EkE, refer to Kadoka series in this table.	Poor: thin	Poor	Severe: siltstone at depth of about 7 inches; 3 to 40 percent slopes.	Severe: 3 to 40 percent slopes.
Goshen (GoA)	Good	Fair to poor	Moderate: some flooding.	Moderate: variable permeability in substratum.
Haverson (HhA, HlA, HoA)	Fair if fertilized: high in lime content.	Good to poor	Moderate: some flooding.	Severe: rapid permeability in substratum.
Hisle (Hs)	Not suitable	Very poor	Severe: slow permeability.	Moderate: unstable material.
Hoven (Hv)	Not suitable	Very poor	Severe: flooding; slow permeability.	Slight.
Huggins (HwA)	Good	Poor	Moderate: siltstone at depth of 20 to 40 inches.	Moderate: siltstone at depth of 20 to 40 inches.
Kadoka (KaA, KaB, KaC, KbC, KdC). For properties of Epping soil in KbC and for Huggins soil in KdC, refer to those series in this table.	Good	Poor	Moderate: 0 to 18 percent slopes.	Moderate: 0 to 18 percent slopes.
Keith (KeA, KeB, KhD, KhE, KrB, KsC, KuC). For properties of Colby soil in KhD and KhE; for Rosebud soil in KrB and KsC; for Canyon soil in KsC; and for Ulysses soil in KuC, refer to those series in this table.	Good	Fair to poor	Moderate: 0 to 25 percent slopes.	Moderate: 0 to 25 percent slopes.
Kyle (KyA)	Poor: high in clay content.	Very poor	Severe: slow permeability.	Slight.
Manter	Fair: blows easily	Good	Slight	Severe: rapid permeability.
Minatare	Not suitable	Very poor	Severe: slow permeability; water table at depth of 2 to 5 feet.	Severe: water table at depth of 2 to 5 feet; unstable material.
Mosher (Mm). For properties of Minatare soil, refer to Minatare series in this table.	Good	Poor	Severe: slow permeability; water table at depth of 4 to 7 feet.	Moderate: unstable fill material.
Oglala (OcE). For properties of Canyon soil, refer to Canyon series in this table.	Good	Fair	Moderate: 9 to 18 percent slopes.	Severe to moderate: 9 to 18 percent slopes.
Pierre (PeC, PsE). For properties of Samsil soil in PsE, refer to Samsil series in this table.	Poor: high in clay content.	Very poor	Severe: slow permeability.	Moderate: 3 to 25 percent slopes; unstable material.

engineering properties

Soil features affecting—				
Highways	Farm ponds		Terraces and diversions	Foundations for low buildings
	Reservoir areas	Embankments		
Moderate susceptibility to frost heaving.	Generally too porous to hold water.	Fair stability.	Sand and gravel at depth of 20 to 40 inches.	Most features favorable; fair shear strength.
Susceptibility to soil blowing.	Too porous to hold water.	Sandy material; rapid seepage.	Sandy substratum; erodible material.	Most features favorable; fair shear strength.
5 to 40 percent slopes; erodible material.	Pervious substratum requires compacted seal blanket.	Poor stability; poor compaction; susceptibility to piping.	Soft sandstone; erodible material; difficult to establish vegetation.	Fair to poor bearing capacity.
9 to 25 percent slopes; erodible material.	Substratum requires compacted seal blanket in places.	Poor stability; poor compaction; susceptibility to piping.	Erodible material.	Poor bearing capacity.
3 to 40 percent slopes; erodible material.	Features usually favorable; requires seal blanket in places.	Limited material; poor stability.	Bedded siltstone at depth of about 7 inches; difficult to establish vegetation.	Poor bearing capacity.
Susceptibility to frost heaving; some flooding.	Features usually favorable; requires seal blanket in places.	Poor stability.	All features favorable.	Poor bearing capacity.
Occasional flooding.	Pervious substratum requires seal blanket.	Fair to poor stability; permeable material.	Erodible material.	Good to fair bearing capacity.
Plastic material; high shrink-swell potential.	Features usually favorable; some seepage in shale crevices.	Fair to poor stability; poor shear strength.	Clay material; unstable material for embankments.	Poor shear strength; high shrink-swell potential.
Susceptibility to frost heaving and flooding; soils depressional.	Features usually favorable.	Fair to poor stability; poor shear strength.	Not applicable.	Not applicable; susceptibility to ponding.
Bedrock at depth of 20 to 40 inches; susceptibility to frost heaving.	Requires seal blanket in places; siltstone at depth of 20 to 40 inches.	Fair to poor stability.	Siltstone at depth of 20 to 40 inches.	Fair bearing capacity; dense siltstone at depth of 20 to 40 inches.
Erodible material.	Features usually favorable; requires seal blanket in places.	Fair to poor stability; susceptibility to piping.	Bedded siltstone at depth of less than 40 inches in places.	Poor to fair bearing capacity.
Susceptibility to frost heaving; erodible material.	Substratum requires seal banket.	Fair to poor stability; susceptibility to piping.	All features favorable.	Poor bearing capacity.
Plastic material; high shrink-swell potential.	All features favorable.	Fair to poor stability; high shrink-swell potential.	Clay material; slow permeability.	Poor shear strength; high shrink-swell potential.
Susceptibility to soil blowing.	Too porous to hold water.	Sandy material; susceptibility to seepage.	Sandy substratum; erodible material.	All features favorable.
Unstable material; susceptibility to frost heaving.	Water table within depth of 5 feet; water brackish in places.	Poor stability.	Not applicable; water table within depth of 5 feet.	Poor bearing capacity; water table within depth of 5 feet.
Susceptibility to frost heaving; water table at depth of 4 to 7 feet in some places.	Too porous in places; water table within depth of 7 feet in some places.	Poor stability.	Water table within depth of 7 feet in some places.	Poor bearing capacity; water table within depth of 7 feet in some places.
9 to 18 percent slopes; erodible material.	Pervious substratum requires seal blanket.	Fair to poor stability; susceptibility to piping.	Features favorable on slopes up to 12 percent.	Fair to poor bearing capacity.
Plastic material; high shrink-swell potential.	All features favorable.	Fair to poor stability; high shrink-swell potential.	Clay material; shale at depth of 20 to 40 inches; slow permeability.	Poor shear strength; high shrink-swell potential.

TABLE 4.—*Interpretations of*

Soil series and map symbols	Suitability as a source of—		Soil limitations for sewage disposal	
	Topsoil	Road fill	Septic tank filter fields	Lagoons
Richfield (RkA, RkC). For properties of Keith soil, refer to Keith series in this table.	Good	Poor	Moderate: moderately slow permeability.	Moderate to slight: unstable material.
Rosebud	Good	Fair	Moderate: 3 to 9 percent slopes.	Moderate: 3 to 9 percent slopes.
Samsil (SpE, Ss). For properties of Pierre soil in SpE, refer to Pierre series in this table.	Poor: thin; high in clay content.	Very poor	Severe: slow permeability; shale at depth of 1 to 2 feet.	Severe: 9 to 25 percent slopes; shale at depth of 1 to 2 feet.
Swanboy (Sw)	Not suitable	Very poor	Severe: slow permeability.	Moderate: unstable material.
Tuthill (TnA, TnC, TuA, TuB, TuC). For properties of Anselmo soil in TnA and TnC and for Manter soil in TuA, TuB, and TuC, refer to those series in this table.	Good	Good	Slight	Severe to moderate: too porous in places.
Ulysses	Good	Fair to poor	Moderate: 5 to 9 percent slopes.	Moderate: 5 to 9 percent slopes.
Valentine (Vs)	Not suitable	Good	Slight	Severe: rapid permeability.
Wanblee (Wa)	Not suitable	Very poor	Severe: slow permeability; siltstone at depth of 2 to 4 feet.	Moderate: unstable material.
Wortman (Ww). For properties of Wanblee soil, refer to Wanblee series in this table.	Fair to good	Poor	Severe: slow permeability; siltstone at depth of 3 to 5 feet.	Moderate: unstable material.

The tests for liquid limit measure the effect of water on the consistence of the soil material. As the moisture content of a clayey soil is increased from a dry state, the material changes from a semisolid to a plastic state. If the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material passes from a semisolid to a plastic state. The liquid limit is the moisture content at which the material passes from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is plastic.

Table 6 (p. 56) presents data obtained by laboratory tests on samples taken along the routes of proposed highways. These tests were performed by the South Dakota Department of Highways. The samples were taken at depth breaks that reflected distinct changes in color and, therefore, may include material from more than one major horizon of a given series.

Several samples of each horizon of the selected soils were tested. Table 6 shows the actual range and the average value for each of several properties. The AASHO and Unified classifications listed at the end of the table were based on the average values.

Formation and Classification of the Soils

This section has three parts. The first part discusses the five factors of soil formation as they relate to the formation of soils in Washabaugh County. The second part discusses some of the processes that lead to the formation of soil horizons. In the third part, the system for classifying soils is described and the soils of this county are placed in the system.

Formation of the Soils

The characteristics of a soil at any given point are determined by the interaction of five major factors of soil formation—climate, plant and animal life, parent material, relief, and time.

Climate

Washabaugh County has a semiarid climate of cold winters and hot summers. This kind of climate promotes moderately slow soil development. Climatic data are given in the section "General Nature of the County."

The climate is fairly uniform throughout the county and presumably is similar to that under which the soils formed. Consequently, climate alone does not account for

engineering properties—Continued

Soil features affecting—				
Highways	Farm ponds: Reservoir areas	Farm ponds: Embankments	Terraces and diversions	Foundations for low buildings
Plastic material; moderate shrink-swell potential.	Substratum requires seal blanket in places; underlain by sand and gravel in places.	Fair to poor stability	All features favorable	Poor to fair bearing capacity.
Erodible material	Pervious substratum requires seal blanket.	Poor stability; poor compaction; susceptibility to piping.	Sandstone or caliche at depth of 20 to 40 inches.	Fair bearing capacity.
Plastic material; moderate shrink-swell potential; erodible material.	Susceptibility to seepage in shale crevices.	Limited material; moderate shrink-swell potential.	Shallow to clay shale	Shallow to shale; moderate shrink-swell potential; poor shear strength.
Very plastic material; high shrink-swell potential.	All features favorable	Poor stability; high shrink-swell potential.	Unstable material for embankments; difficult to establish vegetation.	High shrink-swell potential; poor shear strength.
Susceptiblity to soil blowing.	Generally too porous to hold water.	Fair stability; susceptibility to seepage.	Substratum porous	All features favorable.
Erodible material	Substratum requires seal blanket in places.	Fair to poor stability; susceptibility to piping.	All features favorable	Poor bearing capacity.
Loose sand hinders hauling; erodible material.	Too porous to hold water.	Sandy material; rapid seepage.	Sandy, erodible material	All features favorable.
Unstable material	Features usually favorable.	Poor stability	Unstable material for embankments.	Poor bearing capacity.
Susceptibility to frost heaving; unstable material.	Features usually favorable.	Poor stability	Unstable material for embankments.	Poor bearing capacity.

local differences among the soils. Its effects are modified by the effects of the other four factors of soil formation.

Plant and animal life

Plants, animals, insects, earthworms, bacteria, and fungi are important in the formation of soils. Among the changes they cause are gains in organic matter, gains or losses in plant nutrients, and changes in structure and porosity.

The well-drained, gently sloping soils on uplands in this county have a cover of native mid and short grasses. The kinds of grass vary according to the kinds of soil, but the density is about the same. As a result, the soils have horizons of organic-matter accumulation of about the same thickness. The steeper soils, such as Canyon, Colby, and Epping soils, lose much of the rainfall through runoff. Soils such as these have a less dense grass cover and consequently have thinner horizons of organic-matter accumulation.

The Goshen soils and other nearly level soils, and especially the concave soils, receive runoff, which favors dense growth of mid and tall grasses. Such soils have thick horizons of organic-matter accumulation. The soils in the southern part of the county have scattered stands of stunted ponderosa pine and an understory of grass. This kind of vegetation appears to have had little effect on formation of the soils.

The presence of animal life and the effect on soil formation vary in this county. Earthworm activity is evident in the friable, silty soils, such as Goshen and Keith soils, but less so in fine-textured and coarse-textured soils, such as Pierre and Valentine soils. Burrowing animals have mixed the soil horizons in some places. Prairie dogs have been active in many of the soils on uplands.

Disturbance by man has also altered the soils. The A and B horizons in some fields have been mixed together through tillage, or erosion resulting from tillage has thinned the A horizon. Small cultivated areas of Canyon, Colby, and Epping soils, for example, have been so severely damaged by erosion that the A horizon either is absent or has been mixed with the underlying material and can no longer be identified.

Parent material

Parent material is the disintegrated and partly weathered rock from which soil has formed. It determines the limits of the chemical and physical characteristics of soil and influences such characteristics as color, texture, and consistence. Some of the soils of Washabaugh County formed in material weathered from the underlying geologic formations, and some formed in material trans-

TABLE 5.—*Engineering,*

[Tests performed by the South Dakota Department of Highways in cooperation with the U.S. Bureau of Public Roads

Soil name and location	Underlying material	Depth	Moisture-density data [1]	
			Maximum dry density	Optimum moisture
		In.	*Lb. per cu. ft.*	*Pct.*
Anselmo sandy loam: 645 feet N. and 2,450 feet W. of SE. corner sec. 16, T. 41 N., R. 36 W.	Eolian sand	0–9	118	12
		9–26	115	13
		26–56	118	12
1,125 feet N. and 1,120 feet W. of SE. corner sec. 35, T. 42 N., R. 37 W.	Eolian sand	0–8	118	11
		8–28	120	10
		28–60	118	10
Richfield silt loam: 230 feet W. and 1,320 feet N. of SE. corner sec. 29, T. 44 N., R. 33 W.	Old alluvium	2–7	100	18
		13–29	108	17
		29–40	99	22
		40–60	102	20
1,335 feet N. and 825 feet W. of SE. corner sec. 29, T. 44 N., R. 33 W.	Old alluvium	3–9	100	20
		12–25	100	20
		40–50	114	16
Tuthill fine sandy loam: 2,090 feet W. and 160 feet S. of NE. corner sec. 12, T. 41 N., R. 37 W.	Eolian sand	0–6	114	13
		16–36	117	12
		61–73	119	9

[1] Based on AASHO Designation: T 99–77, Method C (*2*).

[2] Mechanical analysis according to the AASHO Designation: T 88–57 (*2*). Results by this procedure may differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method, and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method, and the material coarser

ported by wind and water. Some kinds of parent material are slow to show the effects of the other four factors of soil formation. Soil formation progresses faster in the more friable, loamy and silty parent material. More changes take place, and the horizons are more distinct.

Pierre shale, the only formation of the Cretaceous system exposed in the county, occurs mostly in the northeastern part. It is a dark-gray, fissile clay shale that contains beds of bentonite and seams of limestone, iron, and manganese concretions. In some areas the shale is highly weathered and is yellowish brown in color. The Kyle, Pierre, and Samsil soils are examples of soils that have inherited many of their characteristics from Pierre shale.

Sediments of Tertiary age occur in most of the county. These sediments, which are of continental origin, are erosional remnants of an upland depositional plain. They were deposited by fresh-water streams after the Cretaceous period. Most of the Tertiary material in this county was derived from two geologic groups—the White River group and the Arikaree group.

The White River group consists of a succession of clay and silt beds. It is represented in this county by the Chadron and the Brule formations. The Chadron formation is mainly greenish-gray, bentonitic silty clay that typically has weathered into rounded humps (*1*). This formation occurs chiefly as eroded, rounded, low mud buttes in basins of the Badlands soil association. The Brule formation, which overlies the Chadron formation, consists of bands of pinkish and grayish siltstone and sandstone interbedded with silty bentonitic claystone (*1*). Huggins, Kadoka, and Epping soils are examples of soils that formed in material weathered from the Brule formation. Much of the Badlands soil association is made up of eroded beds of the White River group.

The Arikaree group is above the White River group and is represented in this county by the Sharps, Monroe Creek, and Harrison formations. The Sharps formation is a pinkish-tan silt that has many small, calcareous concretions, called potato-ball concretions, and a zone of volcanic ash at the base (*4*). The Monroe Creek formation consists of compact, massive, grayish-buff, sandy silt that has many calcareous, nodular concretions at its base and tends to form vertical escarpments (*4*). The Harrison formation consists of gray, massive very fine sand with distinct, lime-cemented layers. The Arikaree group appears in the southern part of the county. Mainly Canyon, Oglala, and Rosebud soils formed in materials weathered from this group. In some places Kadoka and Epping soils formed in material weathered from the basal part of the Sharps formation.

test data

in accordance with standard procedures of the American Association of State Highway Officials (AASHO)(*2*)]

Mechanical analysis [2]					Liquid limit	Plasticity index	Classification	
Percentage passing sieve—				Percentage smaller than 0.005 mm.			AASHO	Unified [3]
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)					
-------------	100	96	30	9	18	3	A-2-4(0)	SM
-------------	100	98	34	15	24	8	A-2-4(0)	SC
-------------	100	95	34	7	20	5	A-2-4(0)	SM-SC
-------------	100	95	34	9	17	4	A-2-4(0)	SM-SC
-------------	100	94	27	11	18	2	A-2-4(0)	SM
-------------	100	94	23	5	17	1	A-2-4(0)	SM
-------------	100	95	79	19	32	9	A-4(8)	ML-CL
-------------	100	95	67	25	37	19	A-6(12)	CL
-------------	100	98	85	35	37	17	A-6(11)	CL
100	99	98	93	33	40	19	A-6(12)	CL
100	99	94	82	23	35	13	A-6(9)	ML-CL
100	99	98	91	37	48	28	A-7-6(17)	CL
100	99	95	80	23	34	12	A-6(9)	ML-CL
-------------	100	94	47	11	22	6	A-4(2)	SM-SC
-------------	100	94	41	15	21	8	A-4(1)	SC
-------------	100	90	17	5	15	2	A-2-4(0)	SM

than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analysis data used in this table are not suitable for naming textural classes for soils.

[3] SCS and BPR have agreed to consider that all soils having plasticity indexes within two points of the A-line are to be given a borderline classification. Examples of borderline classifications obtained by this use are SM-SC and ML-CL.

Deposits of uniformly textured, silty material are scattered throughout the county. They are up to 15 feet thick and mantle various kinds of material. These windblown deposits furnished the parent material of such soils as Colby, Keith, Richfield, and Ulysses soils.

Wind-worked fine sand mantles a small area in the southeastern part of the county. Stringers of sandy material, usually extending in a northwest-southeast direction, occur in the central part and on some of the tablelands and high terraces in the northern part. Valentine soils are examples of soils that formed in loose sand, and Anselmo and Manter soils are examples of soils that formed in sandy material that contained varying amounts of silt and clay.

Alluvium, or water-transported material, can be either old or recent. Some of it is transported from a considerable distance, and some originates locally from the adjacent slopes. Goshen soils are examples of soils that formed in local alluvium. The high terraces and tablelands in the northern part of the county are mantled with alluvium of the late Tertiary to Pleistocene periods. This old alluvium consists of stratified sand, gravel, and loamy material. Locally, the surface has been reworked by wind. Such material has given rise to Altvan and Tuthill soils in some areas. A silty mantle covers the sand and gravel in other areas. Keith, Richfield, and Ulysses soils are examples of soils that formed in this kind of material. Alluvial deposits of the Recent period consist of silt, clay, sand, and gravel on bottom lands and low terraces. Haverson soils are examples of soils that formed in recent alluvium.

Relief

Relief influences soil formation through its effect on drainage and runoff. Canyon, Colby, Epping, and Samsil soils are examples of the steeper soils that lose much of the rainfall through runoff. Such soils form slowly because natural erosion is active. Where the slopes are gentle, runoff is slower and more water enters the soils. Soil formation progresses and results in such soils as Kadoka, Keith, Rosebud, and Pierre soils. Deeper and more nearly complete soil formation occurs where the soils are nearly level or are concave and receive extra water. Examples are Richfield and Goshen soils. Where runoff is ponded, the soil-forming processes are altered and such soils as Hoven soils occur.

Time

The length of time that soil material has been exposed to the other four factors of soil formation is re-

TABLE 6.—*Engineering test data for soil samples taken along proposed highway routes*

[Tests made by the South Dakota Department of Highways. Dashed lines indicate that soils were not tested for that property]

Soil series	Horizon	Number of samples tested	Mechanical analysis: Percentage passing sieve— No. 10 (2.0 mm.) Range	No. 10 Average	No. 40 (0.42 mm.) Range	No. 40 Average	No. 200 (0.074 mm.) Range	No. 200 Average	Percentage smaller than 0.005 mm. Range	Percentage smaller than 0.005 mm. Average	Liquid limit Range	Liquid limit Average	Plasticity index Range	Plasticity index Average	Classification AASHO	Classification Unified
Altvan.	B	1	89	89	86	86	70	70	------	-----	42	42	13	13	A-7-6(9)	ML
	C	1	54	54	46	46	38	38	------	-----	43	43	10	10	A-5(1)	GM
Anselmo.	A	1	100	100	83	83	28	28	------	-----	20	20	1	1	A-2-4(0)	SM
	C	1	100	100	69	69	14	14	------	-----	------	-----	------	-----	A-2-4(0)	SM
Epping.	A	3	100	100	99-100	99	85-94	89	------	-----	34-45	41	8-32	18	A-7-6(11)	CL
	C	3	100	100	96-100	98	80-81	81	------	-----	37-43	41	2-8	5	A-5(8)	ML
Goshen.	B	2	100	100	100	100	92-93	93	------	-----	43-45	44	14-23	19	A-7-6(12)	ML-CL
	C	2	100	100	98-100	99	85-94	90	------	-----	40-43	42	13-19	16	A-7-6(11)	ML-CL
Haverson (silty clay loam).	C	2	100	100	99-100	100	89-90	90	13-23	18	29-43	36	4-18	11	A-6(8)	ML-CL
Kadoka.	A	11	99-100	100	94-100	98	77-99	89	------	-----	32-50	43	5-22	14	A-7-6(10)	ML
	B	8	100	100	97-100	99	90-96	93	------	-----	37-47	42	14-23	17	A-7-6(11)	ML-CL
	C	15	97-100	100	93-100	98	79-98	88	------	-----	38-50	45	5-26	15	A-7-5(11)	ML
Keith.	B	9	100	100	99-100	100	74-95	89	------	-----	32-46	41	12-19	15	A-7-6(10)	ML-CL
	C	7	100	100	99-100	100	87-95	91	------	-----	32-47	42	8-21	17	A-7-6(11)	ML-CL
Richfield.	A	2	100	100	97-100	99	86-92	89	------	-----	40-47	44	12-18	15	A-7-6(11)	ML
	B	2	100	100	98-99	99	82-92	87	------	-----	42	42	13-18	16	A-7-6(11)	ML-CL
	C	2	100	100	96-100	98	78-83	81	------	-----	44-48	46	13-16	15	A-7-5(11)	ML
Tuthill.	C	1	95	95	67	67	24	24	5	5	20	20	2	2	A-2-4(0)	SM
Wortman.	A	2	100	100	95-100	98	83-89	86	------	-----	30-37	34	6-11	9	A-4(8)	ML-CL
	B	4	100	100	97-100	99	88-94	91	------	-----	40-61	50	15-33	23	A-7-6(15)	ML-CL
	C	2	99-100	100	98-99	99	83-90	87	------	-----	31-52	42	4-24	14	A-7-6(10)	ML-CL

flected in the kinds of soil that form. Some landscapes in this county have been stable for a long time, and the soils have well-developed genetic horizons. Good examples are Richfield and Tuthill soils, which are on the high tablelands and terraces in the northern part of the county. The youngest soils, such as Haverson soils, are those that formed in recent alluvium.

Formation of Soil Horizons

The processes that take place in the formation of soil horizons include (1) the accumulation of organic matter, (2) the leaching of calcium carbonates and bases, (3) the reduction and transfer of iron, and (4) the formation and translocation of silicate clay minerals. One or more of these processes have been active in the formation of horizons in the soils of Washabaugh County.

Canyon, Colby, Epping, Haverson, and Valentine soils are examples of soils that have only a small amount of organic matter. Kadoka, Keith, Richfield, Rosebud, and Tuthill soils are among those that have a moderate amount, and Goshen soils are among those that have a moderately large amount.

Most of the well-drained soils that formed in loamy or silty material on uplands have been leached of carbonates to a depth of at least 15 inches. Examples of these are Keith and Rosebud soils. The moderately well drained soils, such as Goshen soils, have been leached to a slightly greater depth. Carbonates have not been leached from the excessively drained soils on uplands, the slowly permeable clay soils, or the young soils that formed in alluvium.

The reduction and transfer of iron, or gleying, occurs only in poorly drained soils, such as those in areas of Wet alluvial land. The process of gleying is evident in the gray color of the subsurface layers of this land type. The reddish-brown and yellowish-brown mottles indicate segregation of iron.

Many of the soils on uplands in this county have B horizons in which there is a distinct and easily observed accumulation of clay minerals, presumably moved down-

ward by water. Soil scientists generally agree that the leaching of bases usually precedes the formation of a horizon of clay accumulation. Exactly how the clay movement proceeds is not clear, but factors associated with the process exist in the material in which the soils of this county formed. These factors include (1) a sufficient amount of clay; (2) the presence of bases as flocculating agents; (3) the presence of dispersion agents, such as sodium; (4) the alternate wetting and drying of the soils; and (5) enough time for the agents of soil formation to act. Kadoka, Keith, Richfield, and Tuthill soils are examples of soils that have a horizon of clay accumulation.

Where substantial amounts of sodium, which is a dispersing agent, accumulate in the clay horizon, the clay is in poor physical condition. Wanblee and Wortman soils are examples of soils that contain sodium.

Classification of the Soils

Soils are classified so that we can more easily remember their significant characteristics, assemble knowledge about them, see their relationships to one another and to the whole environment, and understand their behavior and their response to manipulation. First through classification, and then through use of soil maps, we can apply our knowledge of soils to specific tracts of land.

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (*3*) and revised later (*10*). The system currently used was adopted by the National Cooperative Soil Survey, effective March 1967. This system is under continual study. Readers interested in the development of the system should refer to the latest literature available (*8*, *11*).

In the course of the soil survey program, new soil series must be established and concepts of some established series, especially older ones that have been used little in recent years, must be revised. A proposed new series has tentative status until review of the series concept at National, State, and regional levels of responsibility for soil classification results in a judgment that the new series should be established. Most of the soil series described in this publication had been established earlier. The Hisle, Kadoka, Kyle, Mosher, Oglala, Swanboy, Tuthill, and Wanblee series had tentative status when the survey was sent to the printer.

The current system of classification defines classes in terms of observable or measurable properties of soils. It has six categories. Beginning with the most inclusive, the categories are the order, the suborder, the great group, the subgroup, the family, and the series. The placement of some soil series in the current system, particularly in families, may change as more precise information becomes available. In table 7 the soils of Washabaugh County are classified according to the current system. Following are brief descriptions of the first five categories in the system. The soil series is defined in the section "How This Survey Was Made" and in the Glossary.

ORDER

Ten soil orders are recognized: Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate among soil orders are those that tend to give broad climatic groupings of soils. The two exceptions to this are the Entisols and the Histosols, which occur in many different climates.

TABLE 7.—*Classification of soil series in Washabaugh County* [1]

Series	Family	Subgroup	Order
Altvan	Fine-loamy over sandy or sandy-skeletal, mixed, mesic	Typic Argiustolls	Mollisols.
Anselmo	Coarse-loamy, mixed, mesic	Typic Haplustolls	Mollisols.
Canyon	Loamy, mixed, calcareous, mesic, shallow	Typic Ustorthents	Entisols.
Colby	Fine-silty, mixed, calcareous, mesic	Typic Ustorthents	Entisols.
Epping	Loamy, mixed, calcareous, mesic, shallow	Typic Ustorthents	Entisols.
Goshen	Fine-silty, mixed, mesic	Pachic Argiustolls	Mollisols.
Haverson	Fine-loamy, mixed, calcareous, mesic	Typic Ustifluvents	Entisols.
Hisle	Fine, mixed, mesic	Mollic Natrargids	Aridisols.
Hoven	Fine, montmorillonitic, noncalcareous, mesic	Typic Natraquolls	Mollisols.
Huggins	Fine, mixed, mesic	Typic Argiustolls	Mollisols.
Kadoka	Fine-silty, mixed, mesic	Typic Argiustolls	Mollisols.
Keith	Fine-silty, mixed, mesic	Typic Argiustolls	Mollisols.
Kyle	Very fine, montmorillonitic, mesic	Ustertic Camborthids	Aridisols.
Manter	Coarse-loamy, mixed, mesic	Typic Argiustolls	Mollisols.
Minatare	Fine, mixed, mesic	Mollic Natrargids	Aridisols.
Mosher	Fine, mixed, mesic	Typic Natrustolls	Mollisols.
Oglala	Coarse-silty, mixed, mesic	Typic Haplustolls	Mollisols.
Pierre	Very fine, montmorillonitic, mesic	Ustertic Camborthids	Aridisols.
Richfield	Fine, montmorillonitic, mesic	Typic Argiustolls	Mollisols.
Rosebud	Fine-loamy, mixed, mesic	Typic Argiustolls	Mollisols.
Samsil	Clayey, mixed, calcareous, mesic, shallow	Typic Ustorthents	Entisols.
Swanboy	Very fine, mixed, mesic	Ustertic Camborthids	Aridisols.
Tuthill	Fine-loamy over sandy or sandy-skeletal, mixed, mesic	Typic Argiustolls	Mollisols.
Ulysses	Fine-silty, mixed, mesic	Typic Haplustolls	Mollisols.
Valentine	Sandy, mixed, nonacid, mesic	Typic Ustipsamments	Entisols.
Wanblee	Fine, mixed, mesic	Mollic Natrargids	Aridisols.
Wortman	Fine, mixed, mesic	Typic Natrustolls	Mollisols.

[1] The classifications given in this table were current at the time this survey was written.

As shown in table 7, three soil orders are represented in Washabaugh County: Entisols, Aridisols, and Mollisols. Entisols lack genetic horizons or have only the beginning of such horizons. Soils of this order in Washabaugh County were classified as Alluvial soils, Regosols, and Lithosols under the 1938 system.

Aridisols are primarily soils of dry places. They do not have a sufficient accumulation of organic matter to be dark colored in the uppermost 7 inches. Soils of this order in Washabaugh County were classified as Brown soils and Solonetz soils under the 1938 system.

Mollisols are soft, friable soils that are high in bases and have a sufficient accumulation of organic matter to be dark colored in the uppermost 7 inches or more. This order includes soils that were classified as Chestnut soils and Solonetz soils under the 1938 system.

SUBORDER

Each order is divided into suborders, which are based primarily on characteristics that seem to produce classes with the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of waterlogging, or those that reflect differences resulting from climate or vegetation. (The suborders are not shown separately in table 7, because they are identified by the last part of the second word in the name of the subgroup.)

GREAT GROUP

Each suborder is divided into great groups on the basis of similarity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus has accumulated; or those that have pans that interfere with growth of roots or movement of water. The features used are the self-mulching properties of clay, soil temperature, major differences in chemical composition, and the like. (The great groups are not shown separately in table 7, because they are identified by the last word in the name of the subgroup.)

SUBGROUP

Each great group is divided into subgroups, one representing the central, or typic, segment of the group and the others, called intergrades, that have properties of the group and also one or more properties of another great group, suborder, or order. Subgroups may also be established in those instances where soil properties intergrade outside the range of any recognized great group, suborder, or order.

FAMILY

Families are established within a subgroup primarily on the basis of properties important in the growth of plants or in the behavior of soils when used for engineering. These properties include texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence.

General Nature of the County

Washabaugh County, which is a part of the Pine Ridge Indian Reservation, was created in 1883 by an act of the Dakota Territory legislature. In 1909, the northern boundary was extended to the White River, and in 1911, the eastern boundary was made to conform with the line separating the Pine Ridge Indian Reservation from the Rosebud Indian Reservation. The development of the county has been closely related to the history of the Oglala Sioux Indians (*5*). Fur traders, trappers, and missionaries were the first white settlers. By an act of Congress in 1910, land was opened to homesteaders.

The population increased from 1,166 in 1920 to 2,474 in 1930 and then declined steadily. All the population is rural. The 1960 census lists 1,042 inhabitants. Wanblee, the largest town, has a population of about 200.

No railroad passes through this county. State Route No. 73 crosses the eastern part. Hard-surfaced and gravelled secondary roads connect rural areas and feed into main highways outside the county.

All agricultural products are marketed outside the county. Much of the livestock is sold through barns in adjacent counties, but some is shipped by truck to central markets at Sioux City and Sioux Falls or is shipped on direct consignment to corn-belt feeders. Wheat and other grains are marketed at elevators at Kadoka, Belvidere, and Interior, all in Jackson County.

Washabaugh County has no high school but has seven public elementary schools, most of them one-room schools. Indian children attend schools operated by the Bureau of Indian Affairs at Wanblee and at Kyle in adjacent Shannon County. Many attend the government-operated high school at Pine Ridge in Shannon County, and both white and Indian children attend public high schools at Martin, Interior, and Kadoka in the adjacent counties. Churches of many faiths are at Wanblee and Longvalley.

Hunting, fishing, and amateur baseball provide most of the recreation. One or two dude ranches are located in the northern part of the county. Summer visitors hunt for agates and fossils in areas of Badlands.

There are no mineral resources. Ground water of fair to good quality occurs in the southern half of the county and in scattered areas on high terraces and tablelands in the northern part. The White River, the main stream, has potential for pump irrigation, but the flow is scant in summer. Some of the tributary creeks flow enough in most years to provide water for livestock.

Climate [8]

Washabaugh County has a semiarid, continental climate characterized by cold winters and hot summers. Normally, the precipitation is light in winter and is marginal for crops during the growing season. No large bodies of water are near enough to affect the climate.

Table 8 gives data on temperature and precipitation recorded at the U.S. Weather Bureau Station at Longvalley, in the southeastern part of the county. These data are representative of the rest of the county.

Table 9 shows the probabilities of specified temperatures after certain dates in spring and before certain dates in fall. It can be seen that there is a 50 percent probability that a temperature of 32° F. or lower will occur after May 12.

[8] By WALTER SPUHLER, State climatologist, U.S. Weather Bureau, Brookings, S. Dak.

TABLE 8.—*Temperature and precipitation*

[All data obtained from records at Longvalley for the period 1927–63. Elevation 2,467 feet]

Month	Temperature				Precipitation							
	Average daily maximum	Average daily minimum	Two years in 10 will have—		Average total	Maximum total	Minimum total	One year in 10 will have—		Average total snowfall	Average number of days with—	
			Maximum temperature equal to or higher than—	Minimum temperature equal to or lower than—				Less than—	More than—		Snowfall of 1 inch or more	Depth of snow cover 1 inch or more
	° F.	° F.	° F.	° F.	In.	In.	In.	In.	In.	In.		
January	35.2	9.6	41.7	3.1	0.41	1.85	0	0.17	0.69	5.5	2	6
February	39.4	13.3	46.1	7.2	.43	1.55	0	.09	.88	5.9	2	5
March	46.2	21.2	51.8	15.6	1.14	2.61	.18	.45	1.70	8.4	2	4
April	61.0	33.1	66.2	27.4	1.92	5.66	.13	.69	3.57	3.3	1	1
May	71.2	44.0	76.3	41.2	2.95	8.66	.10	.70	5.60	.9	[1]	[1]
June	80.8	53.3	86.3	50.3	3.03	7.07	.14	1.02	5.72	0	0	0
July	90.8	60.3	94.8	57.6	1.90	5.76	0	.57	3.52	0	0	0
August	89.2	58.8	92.8	56.5	1.86	5.84	.20	.53	3.63	0	0	0
September	79.1	48.1	83.8	44.7	1.11	5.03	0	.07	2.60	.2	[1]	[1]
October	67.5	37.6	72.2	34.3	1.15	3.91	0	.14	2.48	1.2	[1]	[1]
November	49.7	23.4	54.3	20.0	.47	1.81	0	.16	.99	4.5	1	3
December	40.1	15.0	44.9	10.7	.26	1.49	0	.08	.55	4.1	2	6
Year	62.5	34.8			16.63	[2] 27.57	[3] 7.02	11.25	22.63	34.0	10	25

[1] Less than 0.5 day. [2] In 1942. [3] In 1936.

TABLE 9.—*Probabilities of specified temperatures in spring and fall*

[Data obtained from records at Longvalley, 1927–63][1]

Probability	Dates for given probability and temperature					
	16° F. or lower	20° F. or lower	24° F. or lower	28° F. or lower	32° F. or lower	36° F. or lower
After a specified date in spring:						
90 percent	Mar. 10	Mar. 19	Mar. 31	Apr. 11	Apr. 21	May 2
70 percent	Mar. 19	Mar. 29	Apr. 9	Apr. 19	Apr. 29	May 11
50 percent	Apr. 4	Apr. 16	Apr. 23	May 3	May 12	May 26
30 percent	Apr. 18	May 2	May 7	May 16	May 25	June 10
10 percent	Apr. 27	May 12	May 16	May 24	June 2	June 19
Before a specified date in fall:						
10 percent	Oct. 15	Oct. 2	Sept. 26	Sept. 13	Sept. 5	Aug. 31
30 percent	Oct. 23	Oct. 11	Oct. 5	Sept. 22	Sept. 13	Sept. 7
50 percent	Nov. 5	Oct. 26	Oct. 19	Oct. 9	Sept. 26	Sept. 18
70 percent	Nov. 17	Nov. 10	Nov. 2	Oct. 24	Oct. 9	Sept. 28
90 percent	Nov. 24	Nov. 19	Nov. 10	Nov. 2	Oct. 16	Oct. 5

[1] Prepared by WILLIAM F. LYTLE, South Dakota State University.

This county has wide seasonal and daily variations of temperature. Temperatures of 100° or more occur, on the average, about six times in July, five times in August, and about once each in June and September. The temperature falls to 30° below zero or lower about once in 6 years. It falls to 20° below about once each year in January and on 2 days in 3 years in February. On the average, the temperature falls to zero or lower on 21 days each year and fails to climb above zero on at least 1 day each year.

The average annual precipitation at Longvalley is 16.63 inches. Of this amount, 12.77 inches, or about 76 percent, falls during the growing season, which extends from April through September. The amount of precipitation during the growing season ranged from 3.88 inches in 1936 to 23.66 inches in 1942. Thundershowers of widely variable intensity bring most of the rainfall. About once in 2 years, 1 inch or more of rain falls in a 1-hour period; about once in 15 years, 2 inches or more falls in a 1-hour period; about once in 2 years, 2 inches or more falls

in a 24-hour period; and about once in 20 years, 3 inches or more falls in a 24-hour period.

Snow cover effectively protects pastures and fall-seeded crops, but too heavy a cover hinders farmwork. The average annual snowfall totals 34 inches. Between 1927 and 1963, the snowfall ranged from 12 inches in 1937–38 to 71 inches in 1952–53. The heaviest 1-day snowfall, 15 inches, was recorded on January 28, 1944. On the average, 1 inch or more covers the ground 25 days each year. During the winter of 1931–32, there were 82 days that had a cover of 1 inch or more, but during the winters of 1938–39, 1939–40, 1943–44, and 1944–45, no days had this deep a snow cover. Strong winds, which often accompany snowstorms, blow the snow into sheltered areas and leave open areas nearly bare.

In an average year, sunshine can be expected about two-thirds of the daylight hours during the growing season, and about three-fourths of the daylight hours in July and August, the sunniest months.

Southeast winds that average 10 to 11 miles an hour prevail in summer. Northwest winds that average 11 to 12 miles an hour prevail in winter. Winds of 50 miles an hour or more can occur during any month, but they are most likely to occur in summer, during thunderstorms. Thunderstorms occur, on an average, 11 times in June, 11 in July, 9 in August, 8 in May, and 4 in September. There are fewer in the other months. The annual average is 40 to 45. Hailstorms can be expected at Longvalley only about once in 2 years, mostly in June.

The relative humidity has a wide daily variation and, occasionally, a wide day-to-day variation. The average annual humidity is about 80 percent early in the morning and about 50 percent in the afternoon.

The average annual rate of pan evaporation is about 57 inches; the average from May through October is about 45 inches. The average annual rate of lake evaporation is about 70 percent of the rate of pan evaporation.

Agriculture

Ranching and dryland farming are the main enterprises in Washabaugh County. The present trend is toward fewer and larger holdings. According to the 1964 Census of Agriculture, land in farms totaled 589,665 acres, or 86.8 percent of the county. There were 162 farms, of which 58 were 2,000 acres or more in size and only 15 were less than 260 acres. The average size was 3,639.9 acres. Of these 162 farms, 27 were classified as cash-grain farms, 110 as livestock farms and ranches, 8 as general farms, 1 as a dairy farm, and 16 as miscellaneous and unclassified. There were 146 commercial farms and ranches.

Livestock reported in the 1964 census included 30,697 cattle and calves on 151 farms, 1,639 hogs and pigs on 37 farms, 1,805 sheep and lambs on 13 farms, and 5,842 chickens on 85 farms. The number of horses and mules was not reported in the 1964 census; there were 2,361 in 1959.

The major crops in this county are winter wheat, alfalfa, barley, oats, and corn. According to the 1964 census, winter wheat was harvested from 15,144 acres; alfalfa or an alfalfa mixture cut for hay and for dehydrating from 13,762 acres, barley for grain from 3,699 acres, oats for grain from 3,056 acres, and corn for all purposes from 642 acres. Small acreages were reported for spring wheat, rye, sorghum, and flax. Alfalfa seed was harvested from 1,887 acres.

Information about the past history of cropping and livestock raising can be obtained from the annual reports of the South Dakota Crop and Livestock Reporting Service (*9*).

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Glossary

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crop plants is impaired.

Alkaline soil. Any soil that has a pH greater than 7.3. See Reaction, soil.

Bearing capacity (engineering). The capacity of a soil to support loads.

Blowout. An excavation produced by wind action in loose soil, usually sand.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Caliche. A more or less cemented deposit of calcium carbonate in many soils of warm-temperate areas, as in the Southwestern States. The material may consist of soft, thin layers in the soil or of hard, thick beds just beneath the solum, or it may be exposed at the surface by erosion.

Clay. As a soil separate, mineral particles less than 0.002 millimeter in diameter. As a textural class, soil that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Claypan. A compact, slowly permeable soil horizon that contains more clay than the horizons above and below it. A claypan is commonly hard when dry and plastic or stiff when wet.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent; soil will not hold together in a mass.

Friable.—When moist, soil crushes easily under gentle to moderate pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, soil crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, soil is readily deformed by moderate pressure but can be pressed into a lump; forms a wire when rolled between thumb and forefinger.

Sticky.—When wet, soil adheres to other material; tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, soil moderately resists pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, soil breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Eolian soil material. Soil parent material accumulated through wind action; commonly refers to sandy material in dunes.

Erosion. The wearing away of the land surface by wind, running water, and other geological agents.

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors, such as light, moisture, temperature, and the physical condition (or tilth) of the soil, are favorable.

Gravel. Rounded or angular rock fragments that are not prominently flattened and are up to 3 inches in diameter.

Horizon, soil. A layer of soil, approximately parallel to the soil surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon. The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon. The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon. The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has (1) distinctive characteristics caused by accumulation of clay, sesquioxides, humus, or some combination of these; (2) prismatic or blocky structure; (3) redder or stronger colors than the A horizon; or (4) some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon. The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer. Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Loess. A fine-grained, wind-transported deposit consisting dominantly of silt-sized particles.

Mapping unit. Areas of soil of the same kind outlined on the soil map and identified by a symbol.

Permeability. The quality that enables a soil to transmit water and air. Terms used to describe permeability are *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Phase, soil. A subdivision of a soil type, series, or other unit in the soil classification system made because of differences in the soil that affect its management but do not affect its classification in the natural landscape. A soil type, for example, may be divided into phases because of differences in slope, stoniness, thickness, or some other characteristic that affects management.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Mildly alkaline	7.4 to 7.8
Very strongly acid	4.5 to 5.0	Moderately alkaline	7.9 to 8.4
Strongly acid	5.1 to 5.5	Strongly alkaline	8.5 to 9.0
Medium acid	5.6 to 6.0	Very strongly alkaline	9.1 and higher
Slightly acid	6.1 to 6.5		
Neutral	6.6 to 7.3		

Runoff. The part of the precipitation upon a drainage area that is discharged from the area in stream channels. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline-alkali soil. A soil that contains a harmful concentration of salts and exchangeable sodium; or contains harmful salts and has a highly alkaline reaction; or contains harmful salts and exchangeable sodium and is strongly alkaline in reaction. The salts, exchangeable sodium, and alkaline reaction occur in the soil in such location that growth of most crop plants is less than normal.

Sand. As a soil separate, individual rock or mineral fragments ranging from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz, but sand may be of any mineral composition. As a textural class, soil that is 85 percent or more sand and not more than 10 percent clay.

Series. A group of soils having genetic horizons that, except for texture of the surface layer, are similar in differentiating characteristics and in arrangement in the profile.

Shear strength (engineering). The maximum ability of a soil to resist shearing or sliding along internal surfaces within a mass.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on relatively steep slopes and in swelling clays, where there is marked change in moisture content.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are *platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are (1) *single grain* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the profile below plow depth.

Substratum. Any layer beneath the solum, or true soil.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surplus runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in

fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Texture, soil. The relative proportion of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay*, and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Type, soil. A subdivision of a soil series, made on the basis of differences in the texture of the surface layer.

Water-holding capacity. The capacity of a soil to hold water in a form available to plants. The amount of moisture held in soil between field capacity, or about one-third atmosphere of tension, and the wilting coefficient, or about 15 atmospheres of tension.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

310–386—69——5

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. Other information is given in tables as follows:

Acreage and extent, table 1, page 6. Predicted yields, table 2, page 42.
Engineering uses of the soils, table 3, page 46; table 4, page 50; table 5, page 54; and table 6, page 56.

Absence of a range site, capability unit, or windbreak group designation indicates that the mapping unit was not placed in the specified grouping.

Map symbol	Mapping unit	Described on page	Range site		Capability unit		Windbreak group	
			Name	Page	Symbol	Page	Number	Page
Aa	Alluvial land	5	Overflow	33	VIw-1	40	4	43
AlA	Altvan loam, 0 to 3 percent slopes	7	Silty	34	IIIs-1	38	2	43
AlC	Altvan loam, 3 to 9 percent slopes	7	Silty	34	IVe-5	39	2	43
AvD	Anselmo-Valentine complex, 5 to 20 percent slopes	8						
	Anselmo part	--	Sandy	34	VIe-2	40	1	43
	Valentine part	--	Sands	34	VIe-2	40	7	44
Ba	Badlands	8						
	Barren badlands part	--	------------	--	VIIIs-1	41	---	--
	Clayey land part	--	Clayey	34	VIe-1	40	3	43
	Loamy land part	--	Silty	34	VIe-1	40	2	43
Bk	Barren badlands	8	------------	--	VIIIs-1	41	---	--
CaF	Canyon association, 18 to 40 percent slopes	9						
	Canyon part	--	Shallow	34	VIIs-2	41	---	--
	Oglala and Rosebud parts	--	Silty	34	VIe-1	40	2	43
Cc	Canyon-Rock outcrop association	9						
	Canyon part	--	Shallow	34	VIIs-2	41	---	--
	Rock outcrop part	--	------------	--	VIIIs-1	41	---	--
Cy	Clayey land	9	Clayey	34	VIe-1	40	3	43
EhF	Epping complex, 9 to 40 percent slopes	10						
	Epping part	--	Shallow	34	VIIs-2	41	---	--
	Kadoka part	--	Silty	34	VIe-1	40	2	43
EkE	Epping-Kadoka silt loams, 9 to 18 percent slopes	11						
	Epping part	--	Shallow	34	VIs-2	40	---	--
	Kadoka part	--	Silty	34	VIe-1	40	2	43
Er	Epping-Rock outcrop complex	11						
	Epping part	--	Shallow	34	VIIs-2	41	---	--
	Rock outcrop part	--	------------	--	VIIIs-1	41	---	--
GoA	Goshen silt loam, 0 to 3 percent slopes	12	Overflow	33	IIc-1	38	2	43
Gr	Gravelly land	12	Shallow	34	VIIs-2	41	---	--
HhA	Haverson loam, high, 0 to 3 percent slopes	13	Silty	34	IIIc-2	38	2	43
HlA	Haverson loam, low, 0 to 3 percent slopes	13	Overflow	33	IIIw-1	39	2	43
HoA	Haverson silty clay loam, 0 to 3 percent slopes	13	Overflow	33	IIIw-1	39	2	43
Hs	Hisle clay	14	Thin Claypan	35	VIs-1	40	---	--
Hv	Hoven silt loam	15	Closed Depression	33	VIs-1	40	---	--
HwA	Huggins silt loam, 0 to 3 percent slopes	15	Clayey	34	IIIs-1	38	2	43
KaA	Kadoka silt loam, 0 to 3 percent slopes	16	Silty	34	IIIc-1	38	2	43
KaB	Kadoka silt loam, 3 to 5 percent slopes	16	Silty	34	IIIe-1	38	2	43
KaC	Kadoka silt loam, 5 to 9 percent slopes	16	Silty	34	IVe-2	39	2	43
KbC	Kadoka-Epping silt loams, 3 to 9 percent slopes	17						
	Kadoka part	--	Silty	34	IIIe-1	38	2	43
	Epping part	--	Shallow	34	VIs-2	40	---	--
KdC	Kadoka-Huggins complex, 3 to 9 percent slopes	17						
	Kadoka part	--	Silty	34	IIIe-1	38	2	43
	Huggins part	--	Clayey	34	IVe-5	39	2	43

GUIDE TO MAPPING UNITS--CONTINUED

Map symbol	Mapping unit	Described on page	Range site Name	Range site Page	Capability unit Symbol	Capability unit Page	Windbreak group Number	Windbreak group Page
KeA	Keith silt loam, 0 to 3 percent slopes	18	Silty	34	IIc-1	38	2	43
KeB	Keith silt loam, 3 to 5 percent slopes	18	Silty	34	IIe-1	37	2	43
KhD	Keith-Colby silt loams, 9 to 12 percent slopes	18						
	Keith part	--	Silty	34	IVe-1	39	2	43
	Colby part	--	Thin Upland	34	IVe-1	39	2	43
KhE	Keith-Colby silt loams, 12 to 25 percent slopes	18						
	Keith part	--	Silty	34	VIe-1	40	2	43
	Colby part	--	Thin Upland	34	VIe-1	40	2	43
KrB	Keith-Rosebud silt loams, 3 to 5 percent slopes	19	Silty	34	IIe-1	37	2	43
KsC	Keith-Rosebud-Canyon complex, 5 to 9 percent slopes	19						
	Keith and Rosebud parts	--	Silty	34	IIIe-1	38	2	43
	Canyon part	--	Shallow	34	VIs-2	40	---	--
KuC	Keith and Ulysses silt loams, 5 to 9 percent slopes	19	Silty	34	IIIe-1	38	2	43
KyA	Kyle clay, alkali, 0 to 3 percent slopes	20	Clayey	34	IVs-1	40	---	--
Lm	Loamy land	20	Silty	34	VIe-1	40	2	43
Mm	Mosher-Minatare complex	22						
	Mosher part	--	Claypan	34	IVs-2	40	5	43
	Minatare part	--	Thin Claypan	35	VIs-1	40	6	43
OcE	Oglala-Canyon complex, 9 to 18 percent slopes	23						
	Oglala part	--	Silty	34	VIe-1	40	2	43
	Canyon part	--	Shallow	34	VIs-2	40	---	--
PeC	Pierre clay, 3 to 9 percent slopes	24	Clayey	34	IVe-4	39	3	43
PsE	Pierre-Samsil clays, 9 to 25 percent slopes	24						
	Pierre part	--	Clayey	34	VIe-1	40	3	43
	Samsil part	--	Shallow	34	VIs-2	40	---	--
RkA	Richfield and Keith silt loams, 0 to 3 percent slopes	25	Silty	34	IIc-1	38	2	43
RkC	Richfield and Keith silt loams, 3 to 9 percent slopes	25	Silty	34	IIe-1	37	2	43
SpE	Samsil-Pierre clays, 9 to 25 percent slopes	27						
	Samsil part	--	Shallow	34	VIs-2	40	---	--
	Pierre part	--	Clayey	34	VIe-1	40	3	43
Ss	Samsil-Shale outcrop complex	27						
	Samsil part	--	Shallow	34	VIIs-2	41	---	--
	Shale outcrop part	--	------------	--	VIIIs-1	41	---	--
Sw	Swanboy clay	28	Dense Clay	35	VIIs-1	41	---	--
Te	Terrace escarpments	28	Shallow	34	VIIs-2	41	---	--
TnA	Tuthill and Anselmo fine sandy loams, 0 to 3 percent slopes	29	Sandy	34	IIIe-2	38	1	43
TnC	Tuthill and Anselmo fine sandy loams, 3 to 9 percent slopes	29	Sandy	34	IVe-3	39	1	43
TuA	Tuthill and Manter soils, 0 to 3 percent slopes	29						
	Tuthill part	--	Silty	34	IIIe-2	38	1	43
	Manter part	--	Sandy	34	IIIe-2	38	1	43
TuB	Tuthill and Manter soils, 3 to 5 percent slopes	29						
	Tuthill part	--	Silty	34	IIIe-3	38	1	43
	Manter part	--	Sandy	34	IIIe-3	38	1	43
TuC	Tuthill and Manter soils, 5 to 9 percent slopes	29						
	Tuthill part	--	Silty	34	IVe-3	39	1	43
	Manter part	--	Sandy	34	IVe-3	39	1	43

GUIDE TO MAPPING UNITS--CONTINUED

Map symbol	Mapping unit	Described on page	Range site		Capability unit		Windbreak group	
			Name	Page	Symbol	Page	Number	Page
Vs	Valentine sand	30	Sands	34	VIe-2	40	7	44
Wa	Wanblee soils	31	Thin Claypan	35	VIs-1	40	---	--
We	Wet alluvial land	31	Subirrigated	33	Vw-1	40	4	43
Ww	Wortman-Wanblee complex	32						
	Wortman part	--	Claypan	34	IVs-2	40	5	43
	Wanblee part	--	Thin Claypan	35	VIs-1	40	---	--

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Supplemental Nutrition Assistance Program

For additional information dealing with Supplemental Nutrition Assistance Program (SNAP) issues, call either the USDA SNAP Hotline Number at (800) 221-5689, which is also in Spanish, or the State Information/Hotline Numbers (http://directives.sc.egov.usda.gov/33085.wba).

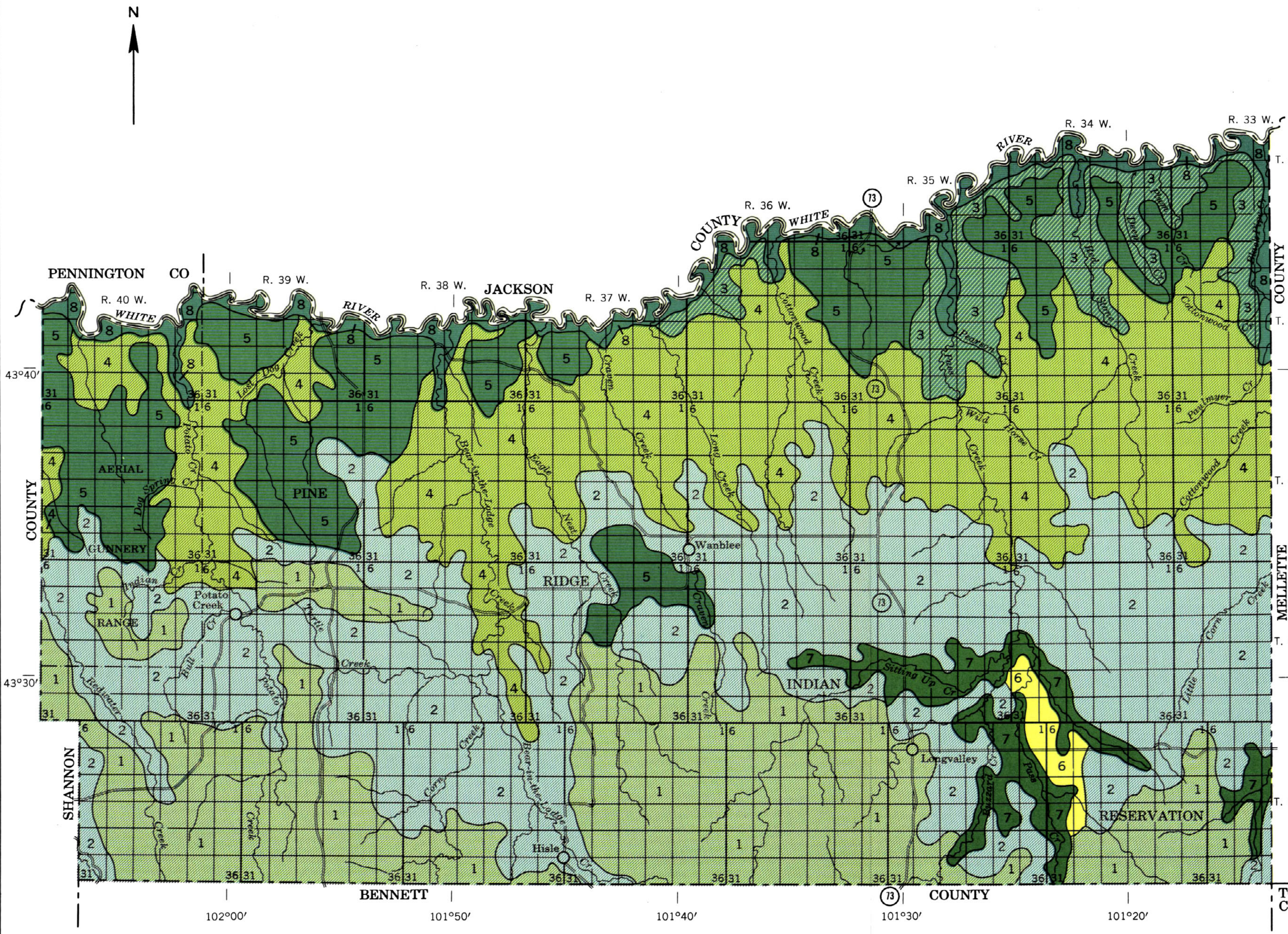
All Other Inquiries

For information not pertaining to civil rights, please refer to the listing of the USDA Agencies and Offices (http://directives.sc.egov.usda.gov/33086.wba).

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
THE UNITED STATES DEPARTMENT OF THE INTERIOR,
BUREAU OF INDIAN AFFAIRS; AND
SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP
WASHABAUGH COUNTY, SOUTH DAKOTA

SCALE IN MILES
1 0 1 2 3 4



SOIL ASSOCIATIONS

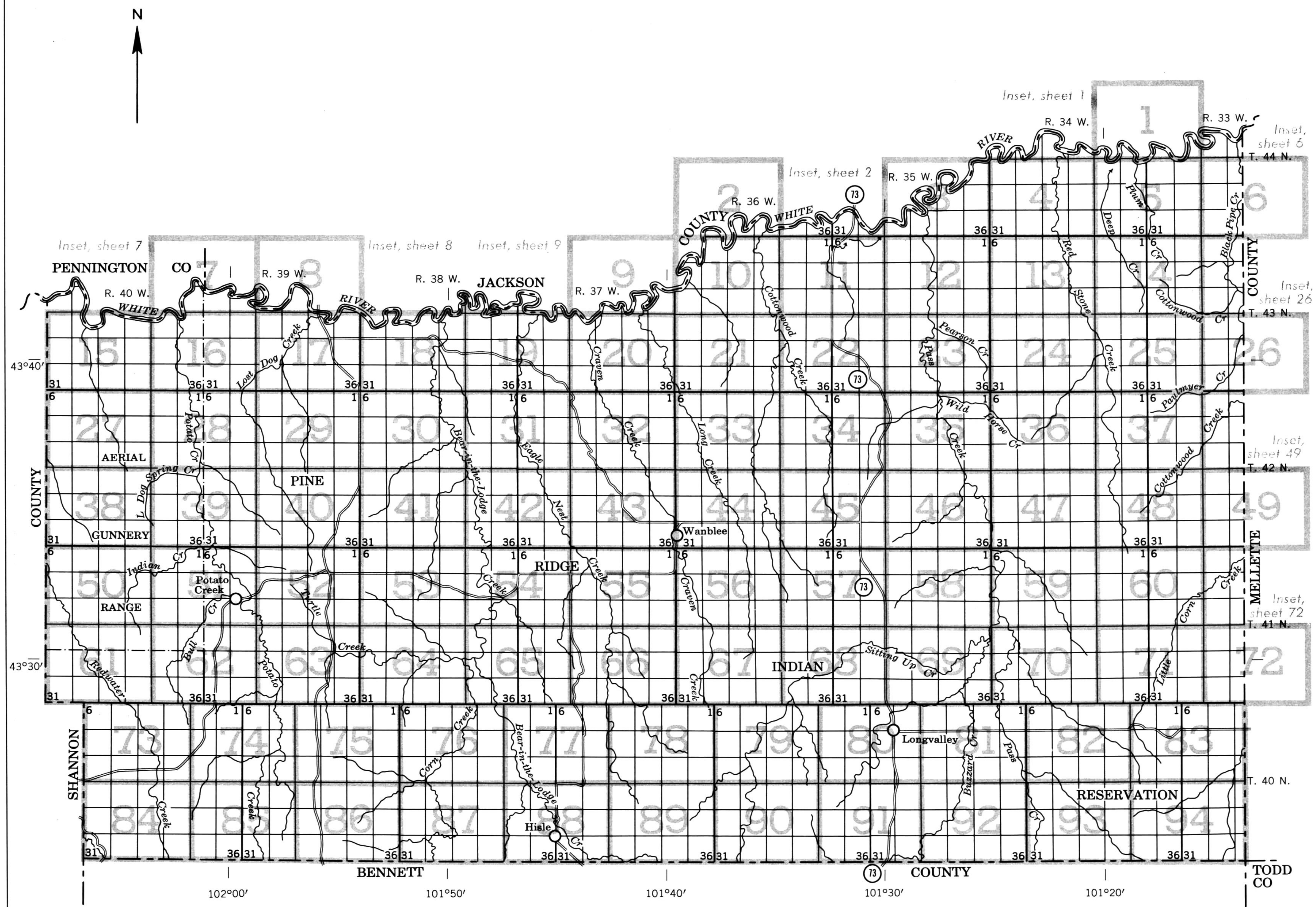
1	Oglala–Canyon–Keith association: Rolling to hilly, well-drained and somewhat excessively drained, loamy soils that are deep and shallow over soft sandstone and deep, silty soils; on uplands
2	Kadoka–Epping association: Gently sloping to hilly, well-drained to excessively drained, silty soils that are deep to shallow over siltstone; on uplands
3	Samsil–Pierre association: Gently sloping to hilly, well-drained to excessively drained, clayey soils that are shallow and moderately deep over clay shale; on uplands
4	Badlands association: Barren badlands intermingled with clayey and loamy soils; in basins and on escarpments, buttes, tablelands, and mesas
5	Tuthill–Keith–Richfield association: Nearly level to undulating, well-drained, deep, loamy soils; on tablelands and terraces
6	Valentine association: Undulating to rolling, excessively drained, deep, sandy soils; on uplands
7	Wortman–Wanblee association: Nearly level and gently sloping, moderately well drained and somewhat poorly drained claypan soils that are moderately deep over siltstone; in swales and on foot slopes, fans, and stream flats
8	Alluvial land–Haverson association: Nearly level and level, loamy soils and mixed alluvial soils; on bottom lands and low terraces

July 1968

INDEX TO MAP SHEETS

WASHABAUGH COUNTY, SOUTH DAKOTA

SCALE IN MILES
1 0 1 2 3 4



SOIL LEGEND

The first capital letter is the initial one of the soil name. A second capital letter, A, B, C, D, E, or F shows the slope. Most symbols without a slope letter are those of soils or land types that are nearly level, but some are for soils and land types that have a considerable range of slope.

SYMBOL	NAME
Aa	Alluvial land
AlA	Altvan loam, 0 to 3 percent slopes
AlC	Altvan loam, 3 to 9 percent slopes
AvD	Anselmo-Valentine complex, 5 to 20 percent slopes
Ba	Badlands
Bk	Barren badlands
CaF	Canyon association, 18 to 40 percent slopes
Cc	Canyon-Rock outcrop association
Cy	Clayey land
EhF	Epping complex, 9 to 40 percent slopes
EkE	Epping-Kadoka silt loams, 9 to 18 percent slopes
Er	Epping-Rock outcrop complex
GoA	Goshen silt loam, 0 to 3 percent slopes
Gr	Gravelly land
HhA	Haverson loam, high, 0 to 3 percent slopes
HlA	Haverson loam, low, 0 to 3 percent slopes
HoA	Haverson silty clay loam, 0 to 3 percent slopes
Hs	Hisle clay
Hv	Hoven silt loam
HwA	Huggins silt loam, 0 to 3 percent slopes
KaA	Kadoka silt loam, 0 to 3 percent slopes
KaB	Kadoka silt loam, 3 to 5 percent slopes
KaC	Kadoka silt loam, 5 to 9 percent slopes
KbC	Kadoka-Epping silt loams, 3 to 9 percent slopes
KdC	Kadoka-Huggins complex, 3 to 9 percent slopes
KeA	Keith silt loam, 0 to 3 percent slopes
KeB	Keith silt loam, 3 to 5 percent slopes
KhD	Keith-Colby silt loams, 9 to 12 percent slopes
KhE	Keith-Colby silt loams, 12 to 25 percent slopes
KrB	Keith-Rosebud silt loams, 3 to 5 percent slopes
KsC	Keith-Rosebud-Canyon complex, 5 to 9 percent slopes
KuC	Keith and Ulysses silt loams, 5 to 9 percent slopes
KyA	Kyle clay, alkali, 0 to 3 percent slopes
Lm	Loamy land
Mm	Mosher-Minatare complex
OcE	Oglala-Canyon complex, 9 to 18 percent slopes
PeC	Pierre clay, 3 to 9 percent slopes
PsE	Pierre-Samsil clays, 9 to 25 percent slopes
RkA	Richfield and Keith silt loams, 0 to 3 percent slopes
RkC	Richfield and Keith silt loams, 3 to 9 percent slopes
SpE	Samsil-Pierre clays, 9 to 25 percent slopes
Ss	Samsil-Shale outcrop complex
Sw	Swanboy clay
Te	Terrace escarpments
TnA	Tuthill and Anselmo fine sandy loams, 0 to 3 percent slopes
TnC	Tuthill and Anselmo fine sandy loams, 3 to 9 percent slopes
TuA	Tuthill and Manter soils, 0 to 3 percent slopes
TuB	Tuthill and Manter soils, 3 to 5 percent slopes
TuC	Tuthill and Manter soils, 5 to 9 percent slopes
Vs	Valentine sand
Wa	Wanblee soils
We	Wet alluvial land
Ww	Wortman-Wanblee complex

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Dual
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State or county

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail, foot
- Railroad
- Ferry (FY)
- Ford (FORD)
- Grade
- R. R. over
- R. R. under
- Tunnel

Buildings

School

Church

Windmill

Mines and Quarries

Mine dump

Pits, gravel or other

Fence

Fence on county line

Cemetery

Dams

Levee

Tanks

BOUNDARIES

- National or state
- County
- Reservation
- Land grant
- Small park, cemetery, airport
- Land survey division corners

DRAINAGE

Streams, double-line
- Perennial
- Intermittent

Streams, single-line
- Perennial
- Intermittent
  - Crossable with tillage implements
  - Not crossable with tillage implements
  - Unclassified

Canals and ditches (CANAL)

Lakes and ponds
- Perennial (water, w)
- Intermittent

Wells, water (flowing)

Spring

Well or spring and tank

Marsh or swamp

Wet spot

Alluvial fan

Drainage end

RELIEF

Escarpments

SOIL SURVEY DATA

Soil boundary and symbol (Dx)

Gravel

Stony, very stony

Rock outcrops

Chert fragments

Clay spot

Sand spot

Gumbo or scabby spot

Made land

Severely eroded spot

Blowout, wind erosion

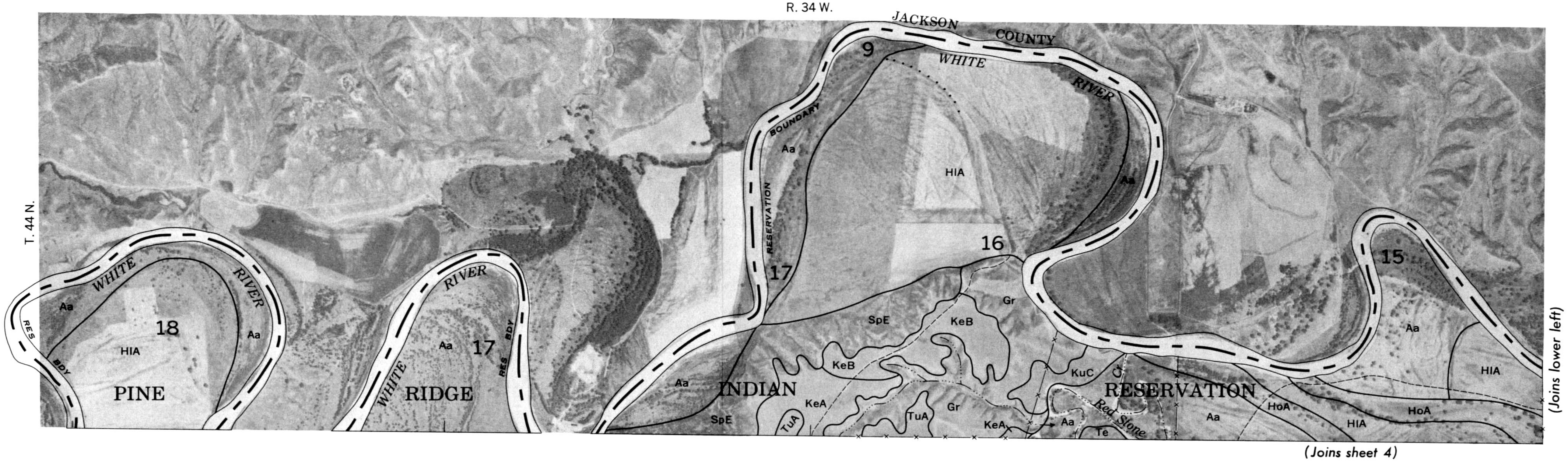
Gully

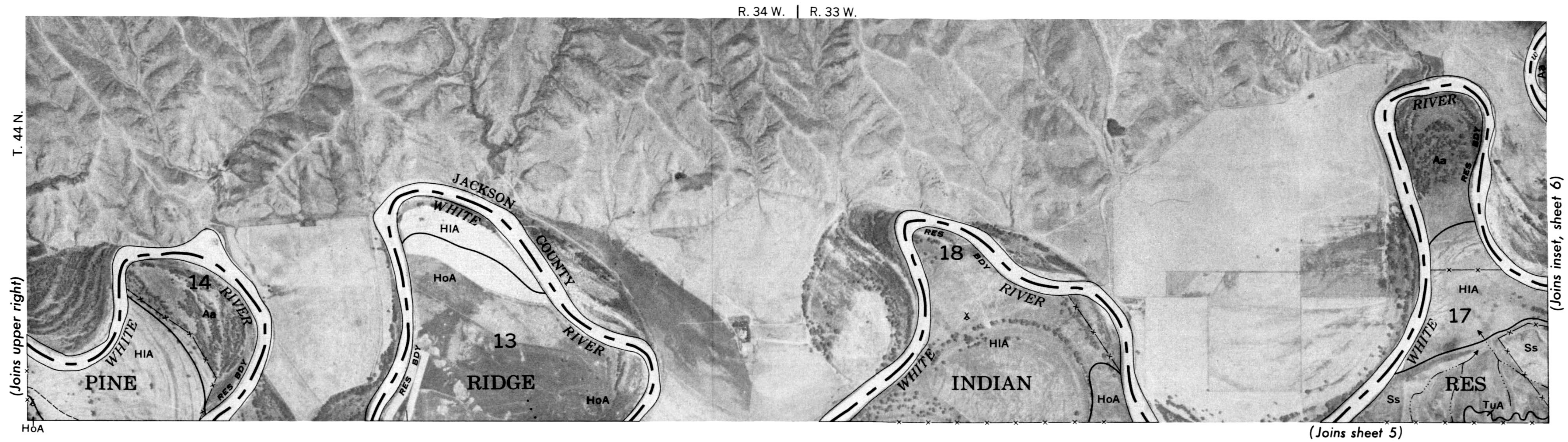
Steep slope or terraced soil

Soil map constructed 1967 by Cartographic Division, Soil Conservation Service, USDA, from 1961 aerial photographs. Controlled mosaic based on South Dakota plane coordinate system, south zone, Lambert conformal conic projection, 1927 North American datum.

1

N





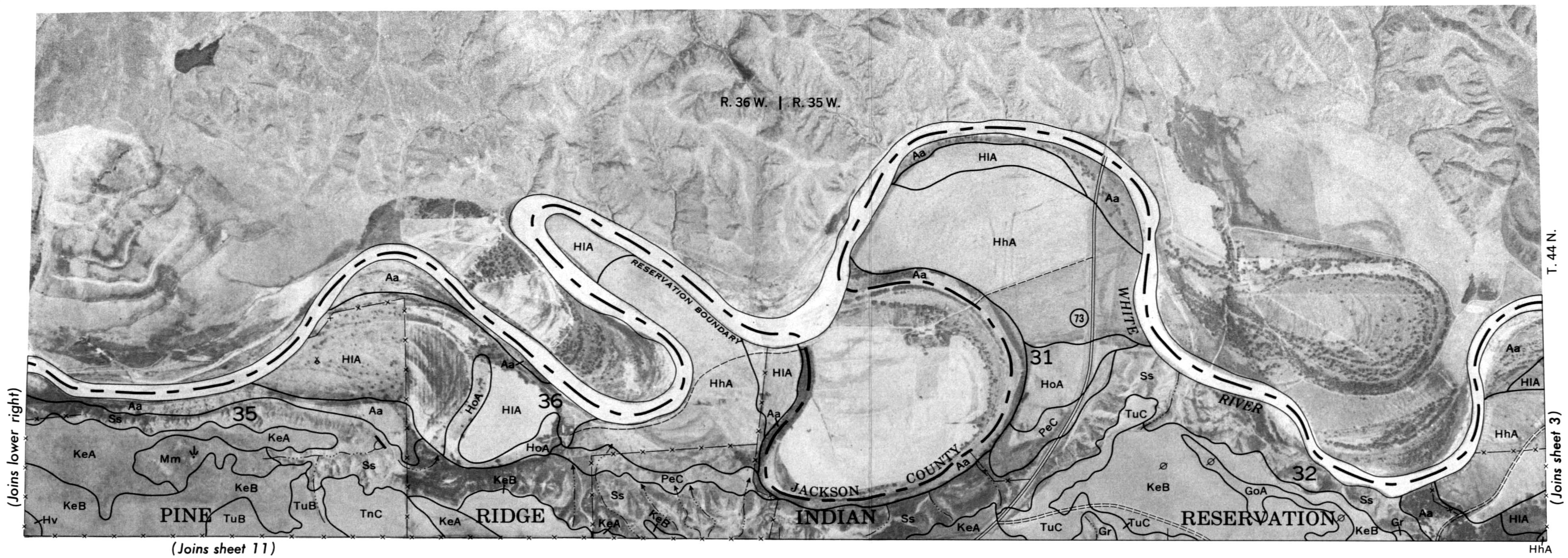
0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

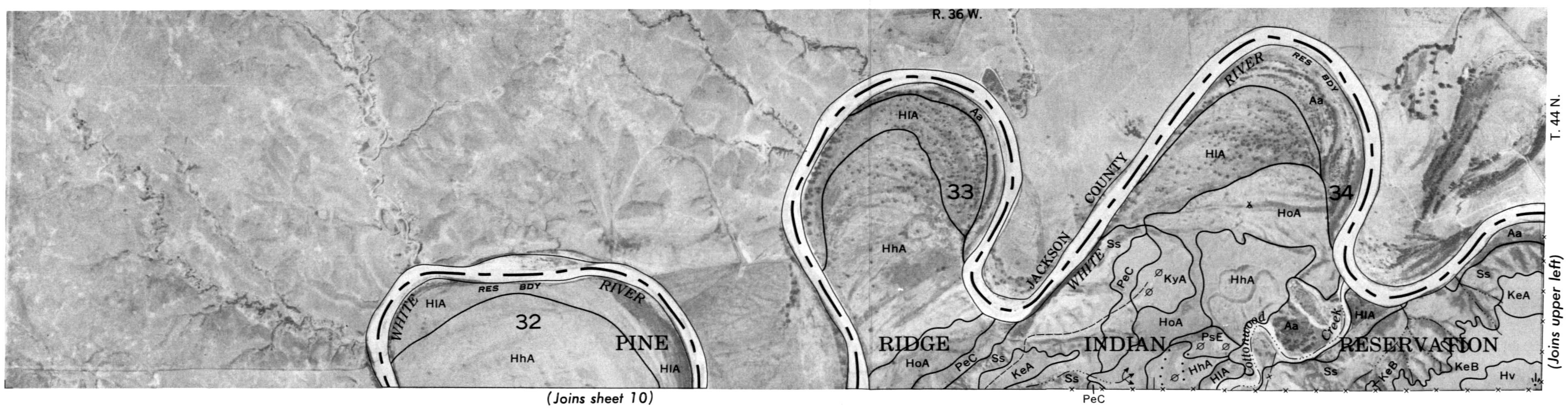
This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 1

2

N





0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 2

Land division corners are approximately positioned on this map.

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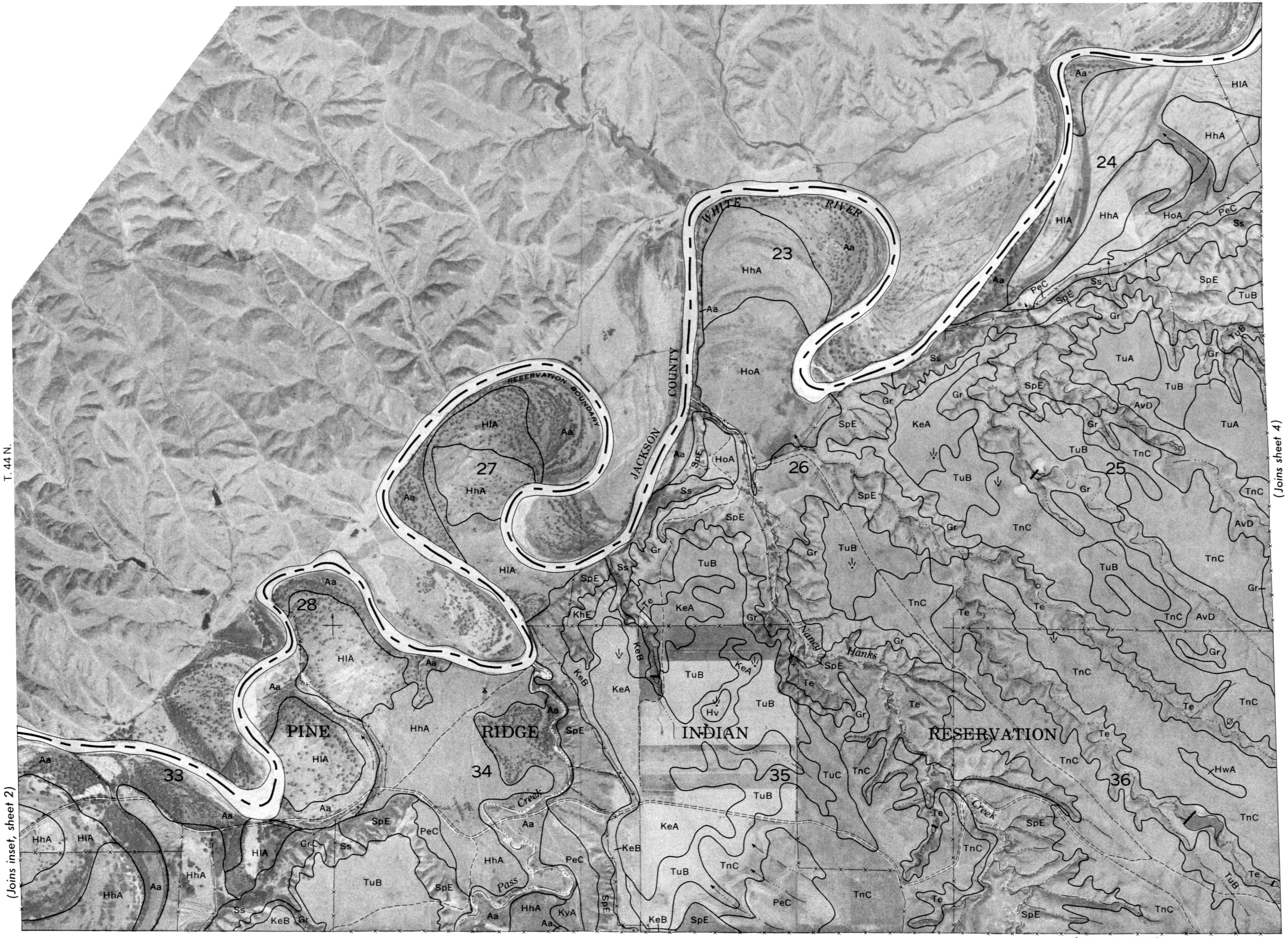
3

R. 35 W.

T. 44 N.



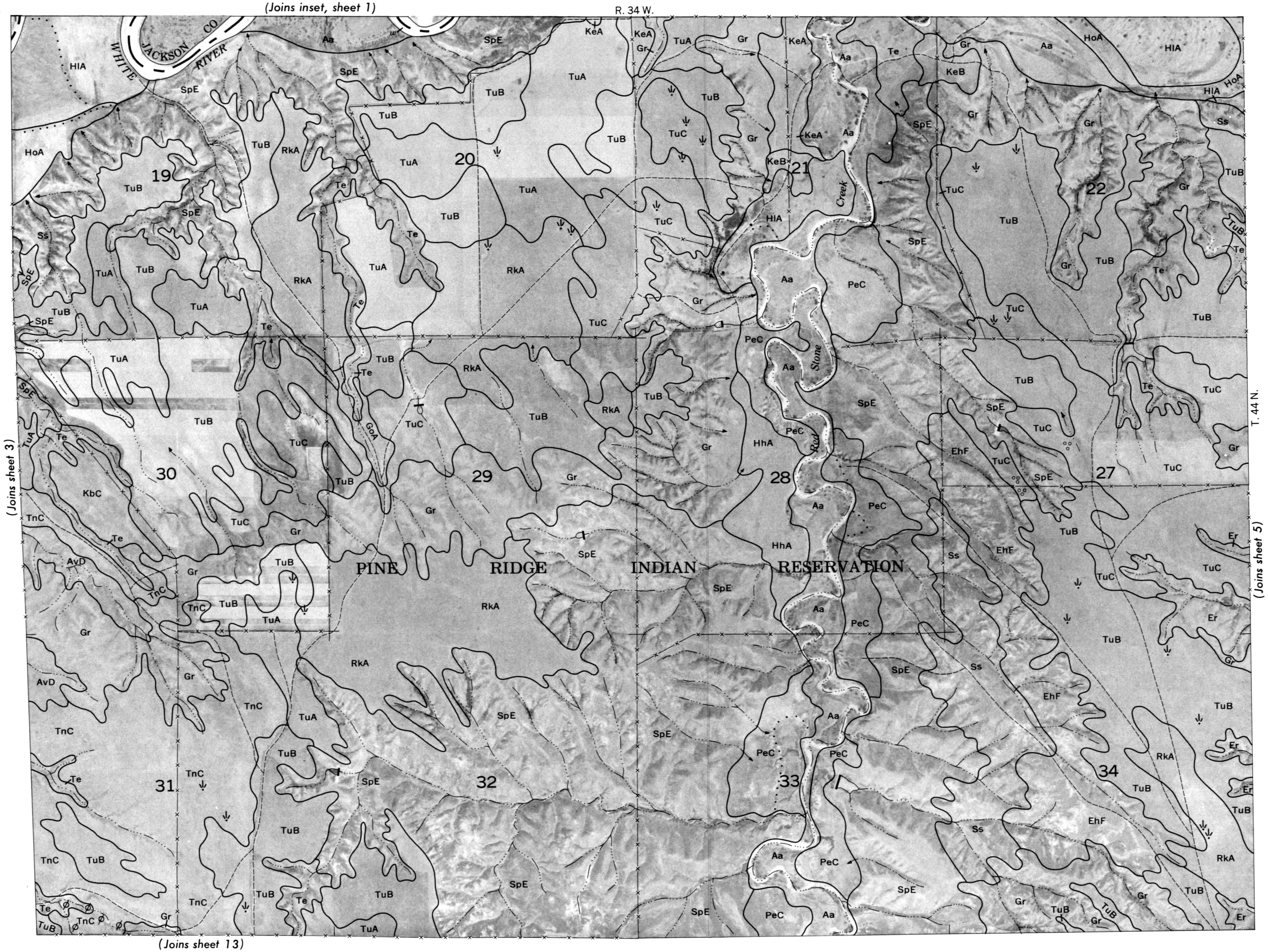
(Joins sheet 4)

(Joins inset, sheet 2)

(Joins sheet 12)

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.
Land division corners are approximately positioned on this map.



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 4

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.

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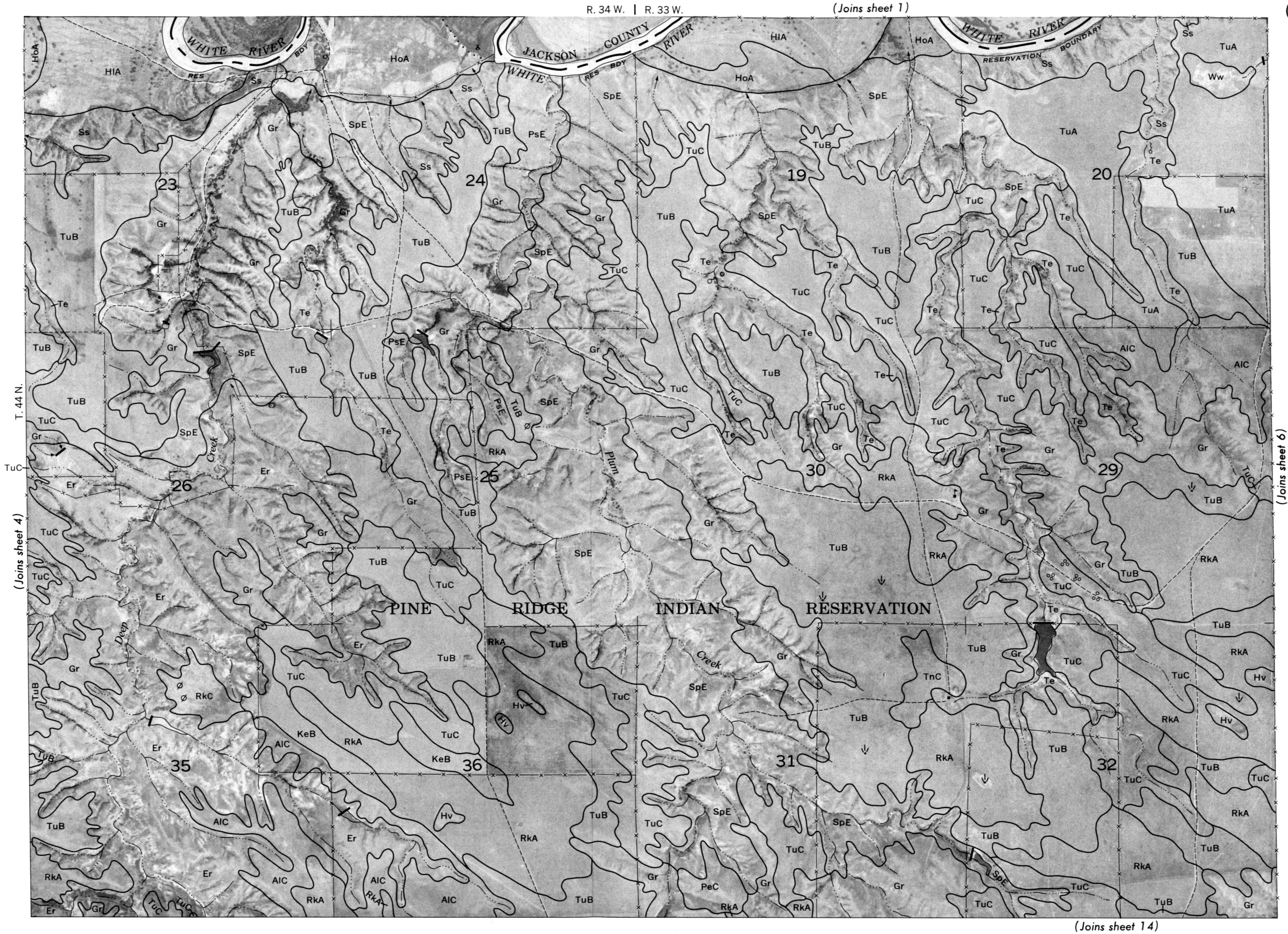
Land division corners are approximately positioned on this map.

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 5



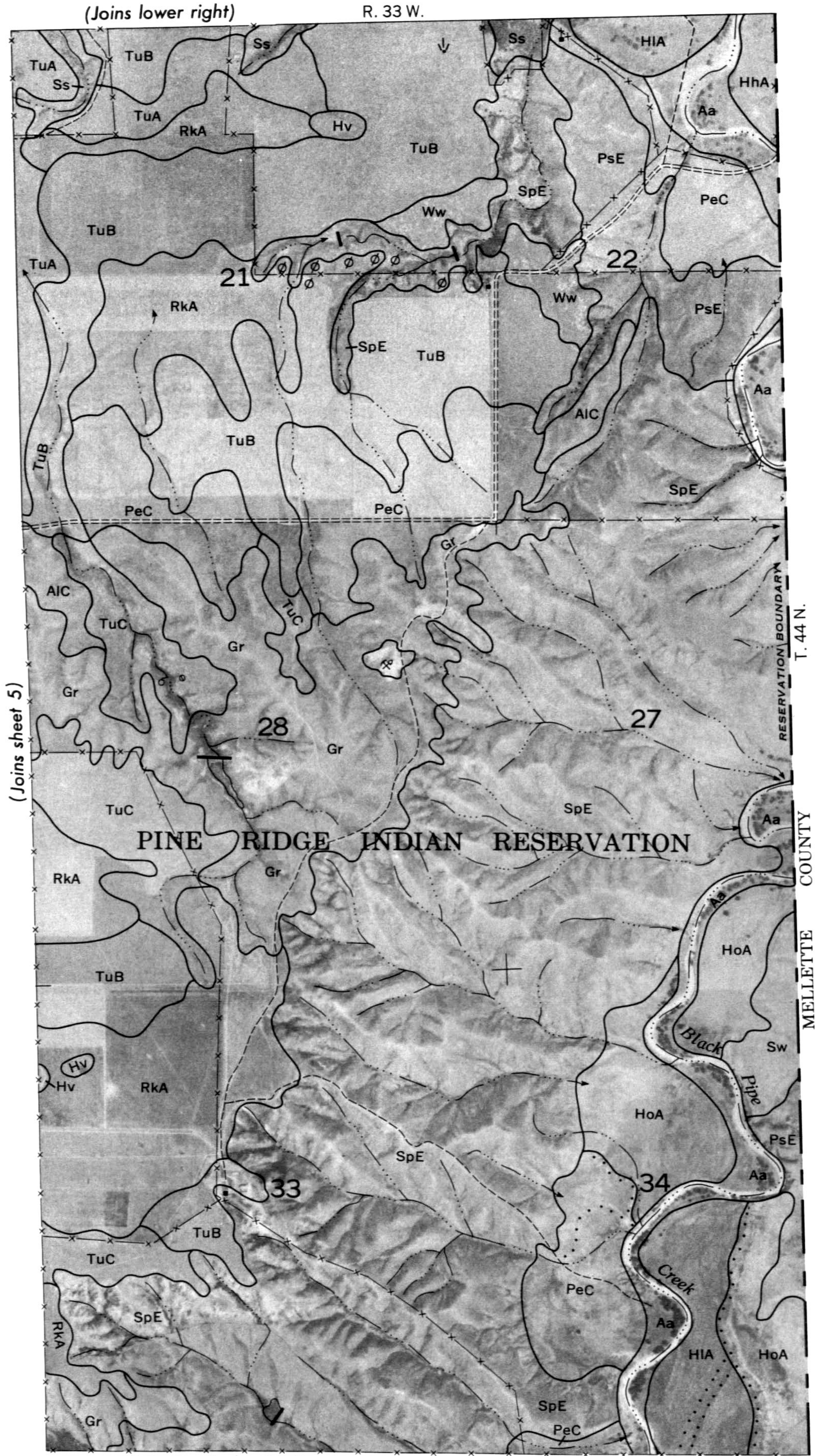
0 ½ 1 Mile

Scale 1:20 000

0 5 000 Feet

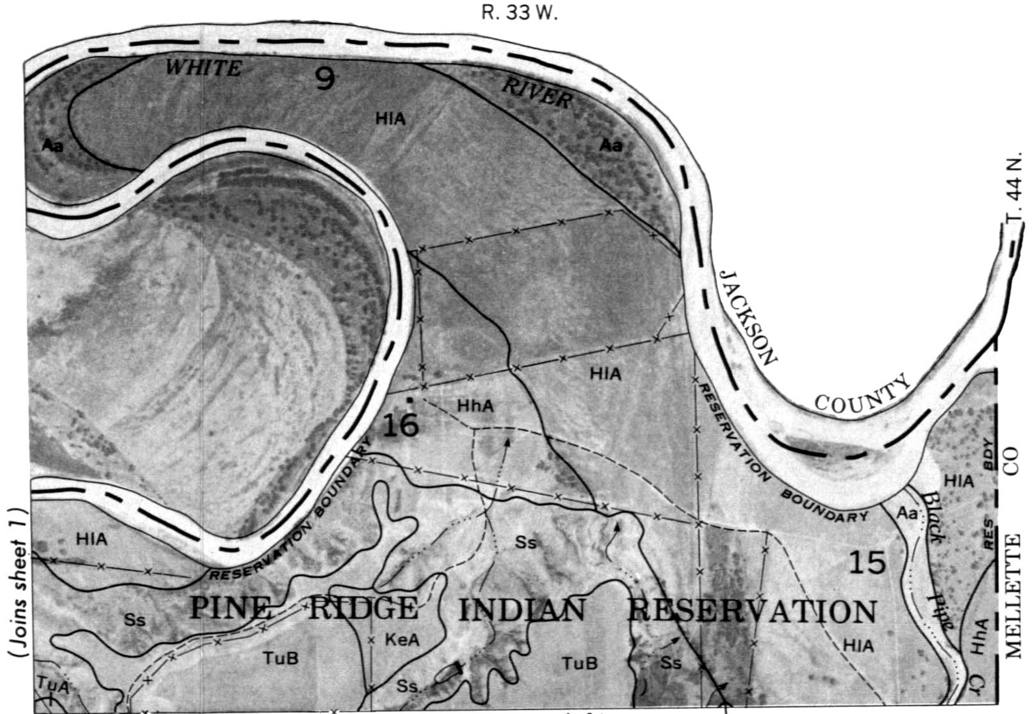
6

(Joins lower right)



(Joins sheet 5)

(Joins inset, sheet 26)



(Joins sheet 1)

(Joins upper left)

0 ½ 1 Mile

Scale 1:20 000

0 5 000 Feet

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 6

Land division corners are approximately positioned on this map.

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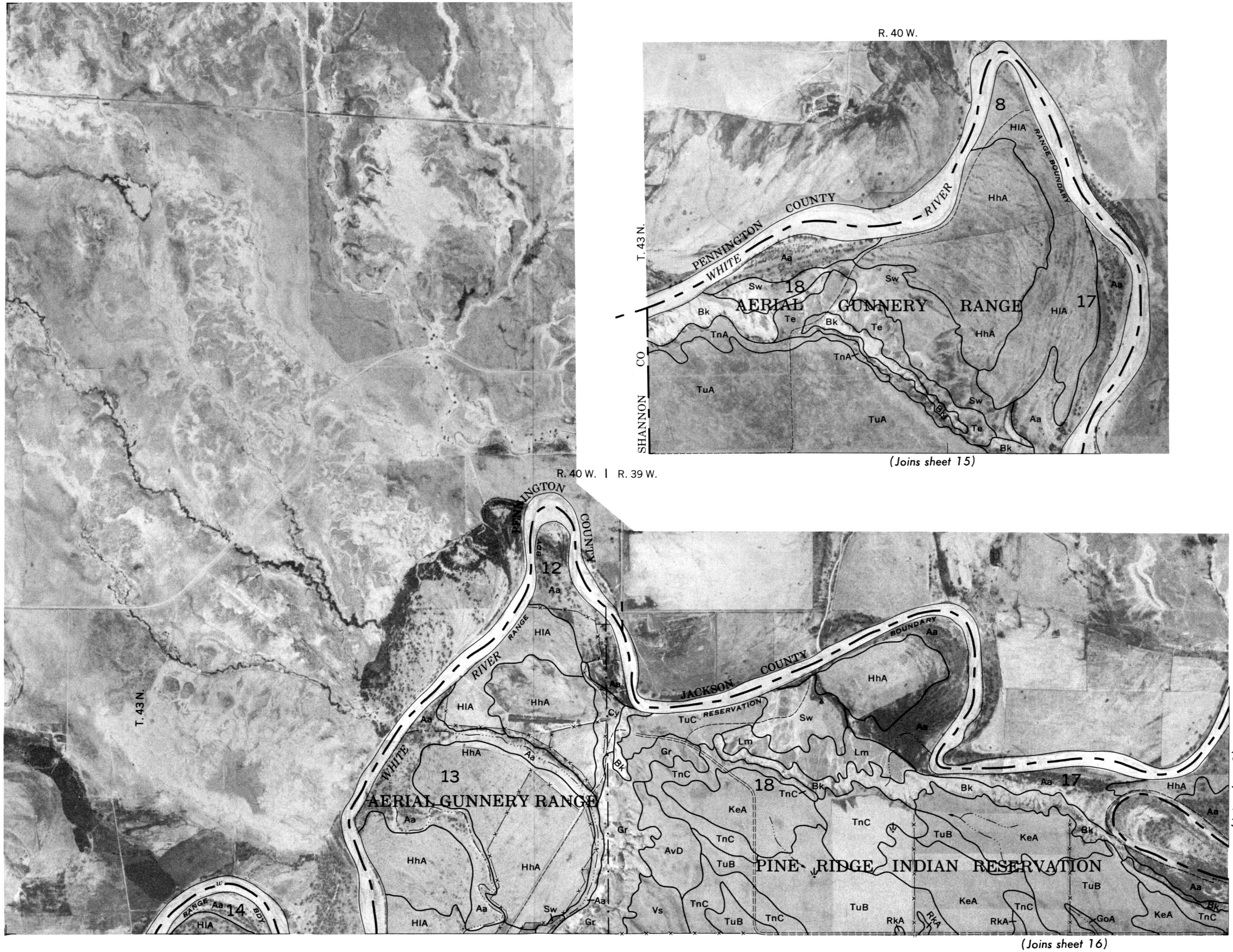
Land division corners are approximately positioned on this map.

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 7



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

8

N

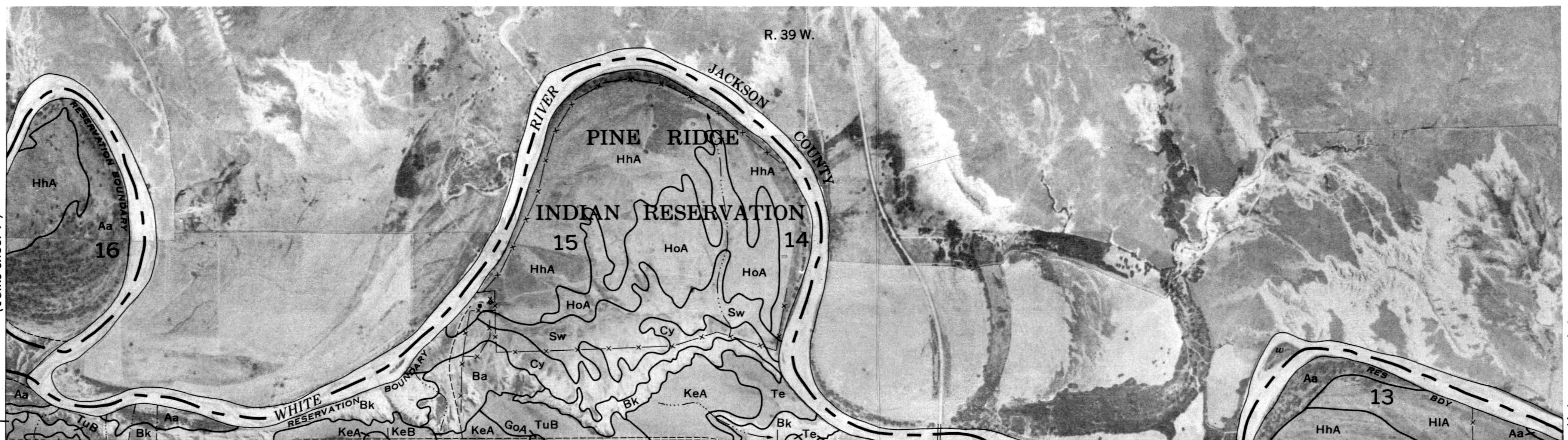
(Joins lower right)

(Joins inset, sheet 9)

Aa

(Joins sheet 18)

(Joins sheet 7)



(Joins upper left)

TnC

KeA

(Joins sheet 17)

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 8

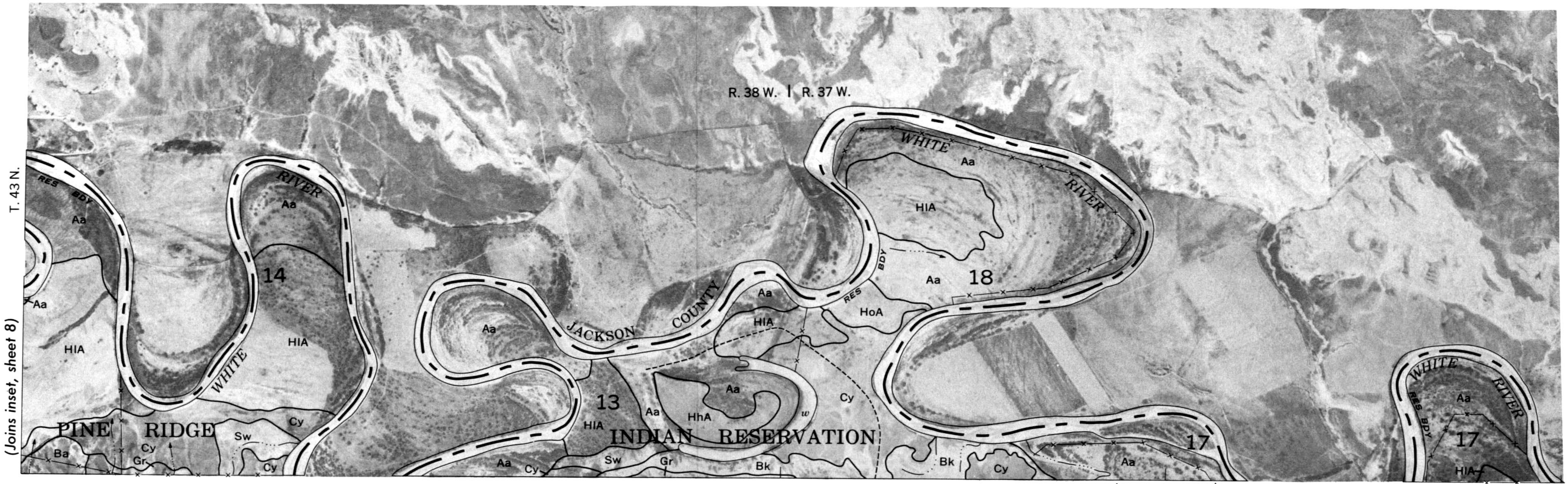
Land division corners are approximately positioned on this map.

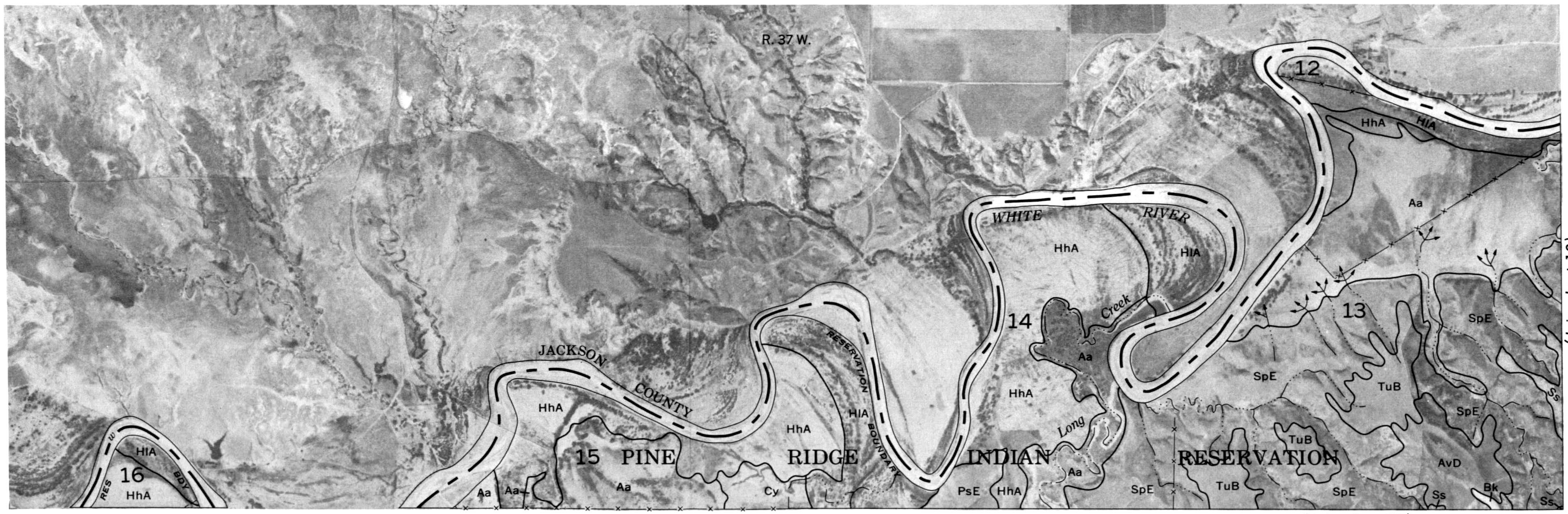
This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.

9

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 9

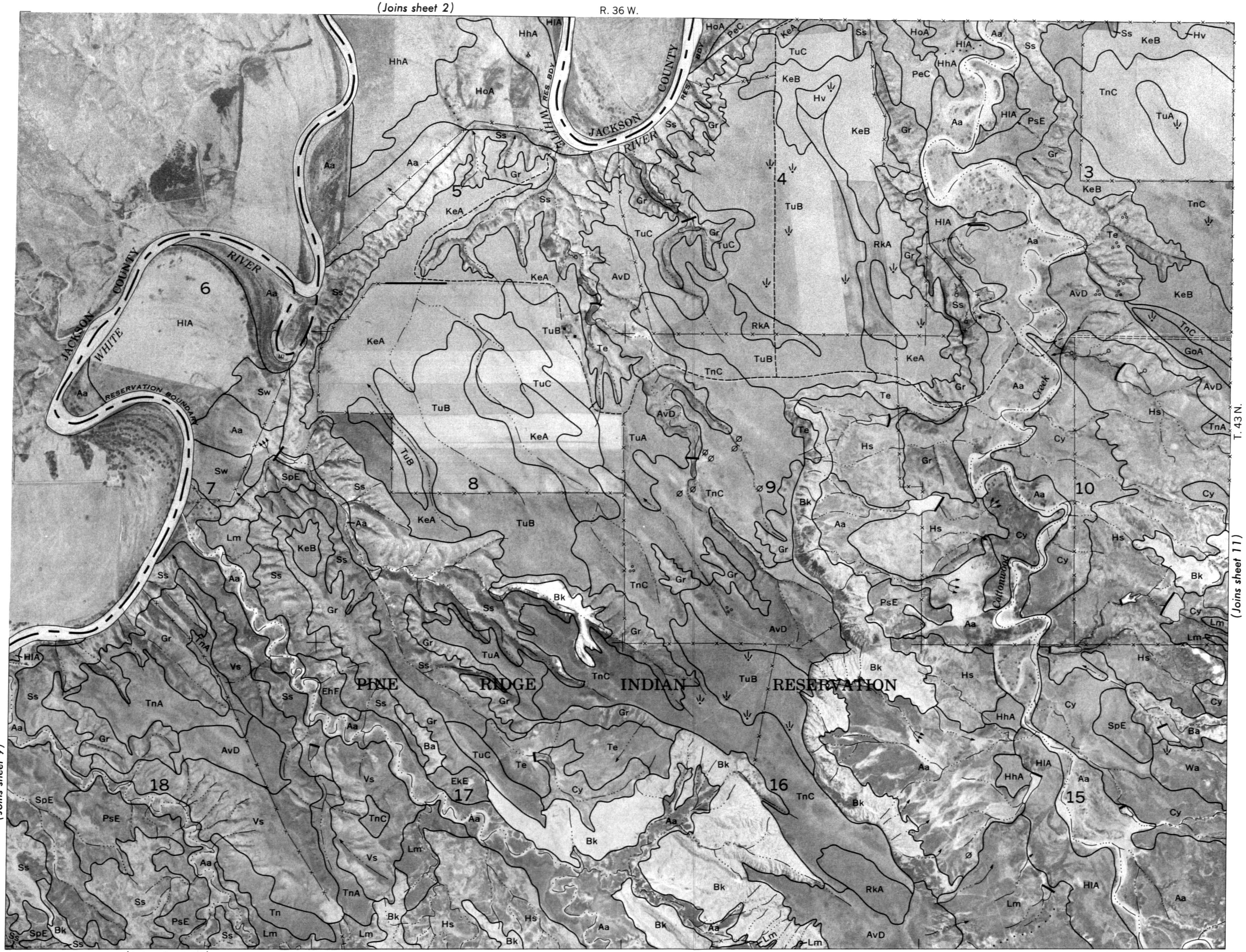




0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

(10)

(Joins sheet 2)



(Joins sheet 9)

(Joins sheet 11)

(Joins sheet 21)

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 10

Land division corners are approximately positioned on this map.

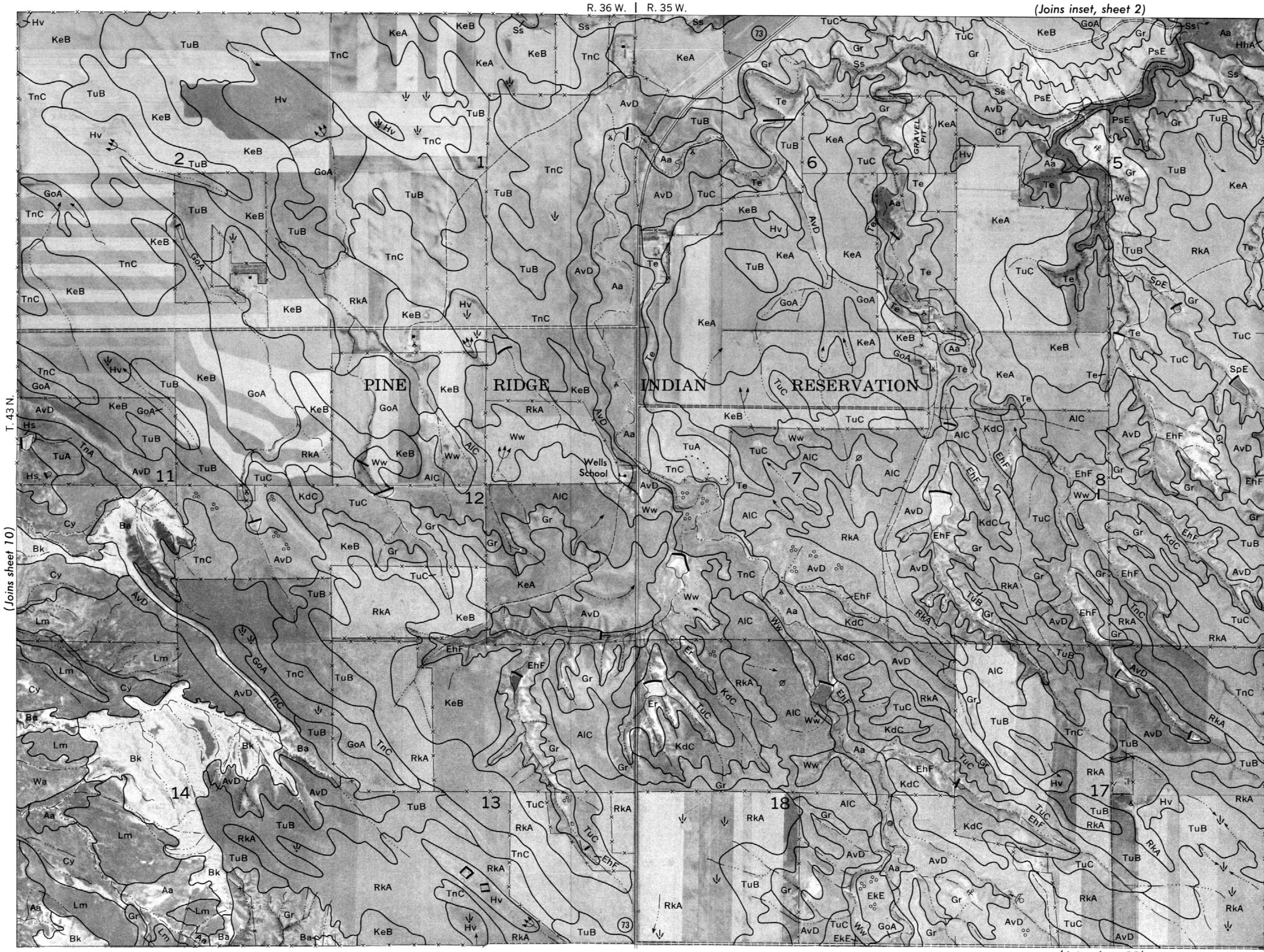
This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.

(11)

R. 36 W. | R. 35 W.

(Joins inset, sheet 2)

(Joins sheet 10)



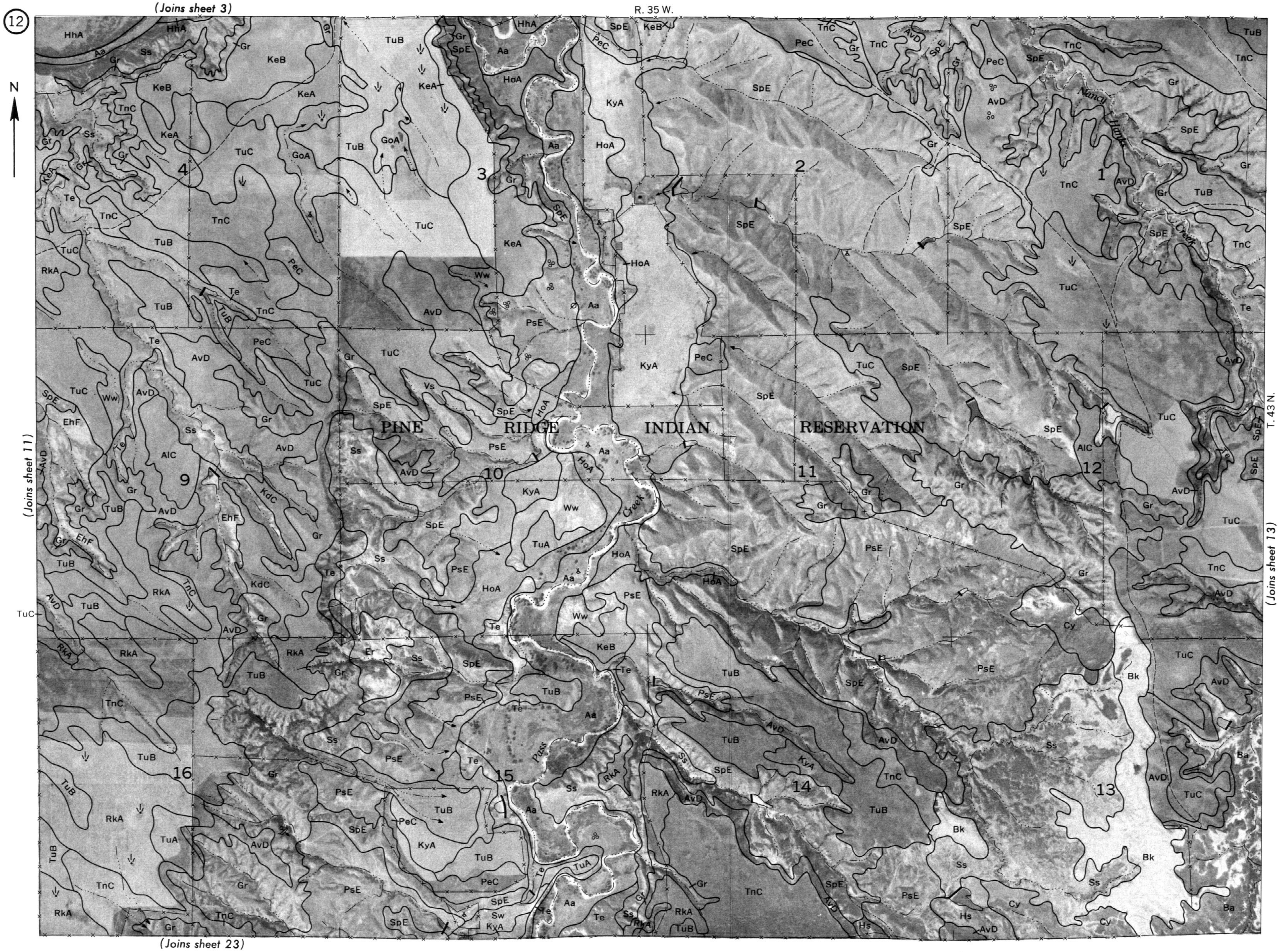
(Joins sheet 12)

(Joins sheet 22)

0 ½ 1 Mile
Scale 1:20 000
0 5 000 Feet

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 11



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 12

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 13

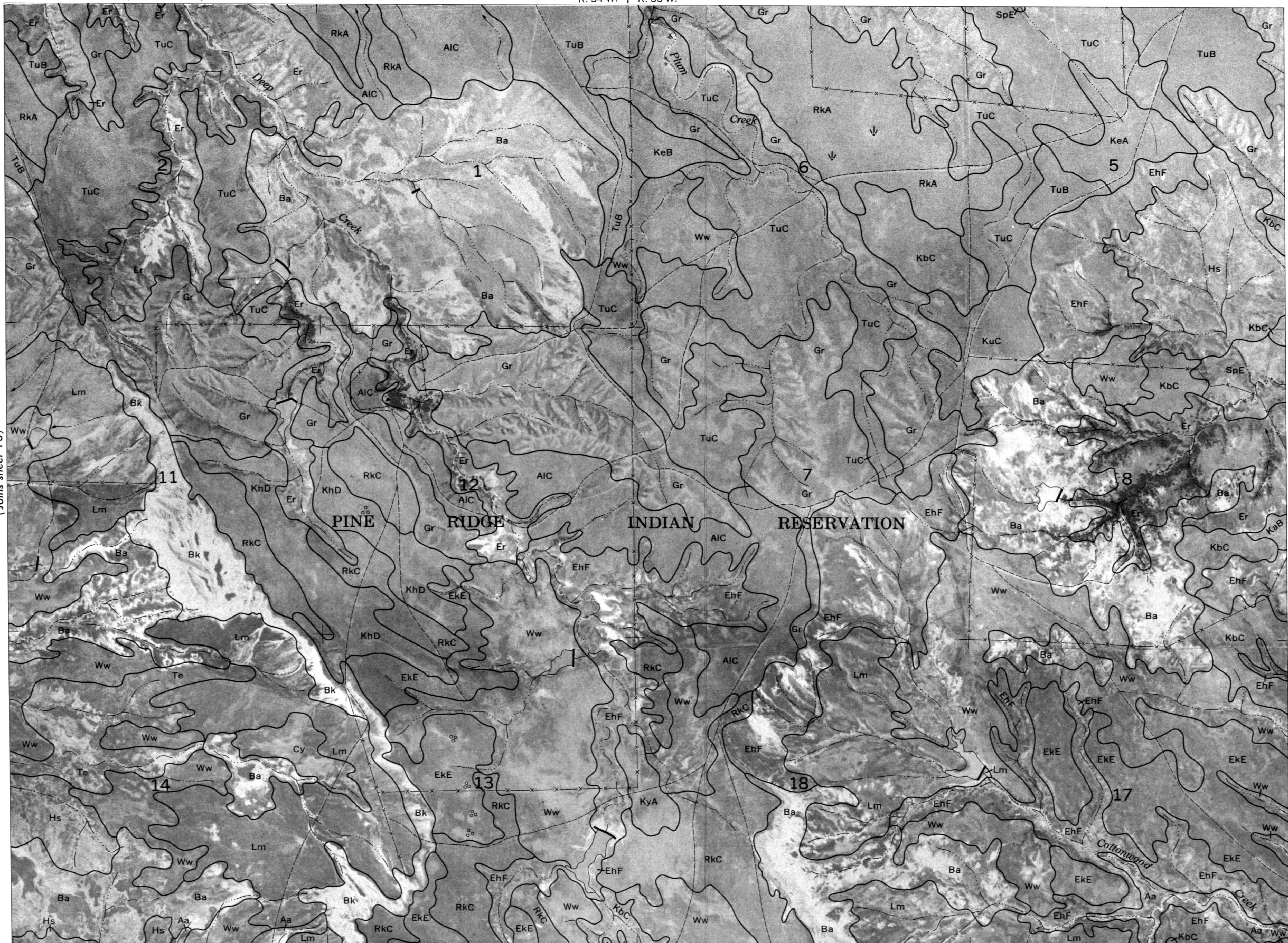
(14)

(Joins sheet 5)

R. 34 W. | R. 33 W.

N

(Joins sheet 13)



(Joins inset, sheet 26)

(Joins sheet 25)

0 ½ 1 Mile

Scale 1:20 000

0 5 000 Feet

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 14

Land division corners are approximately positioned on this map.

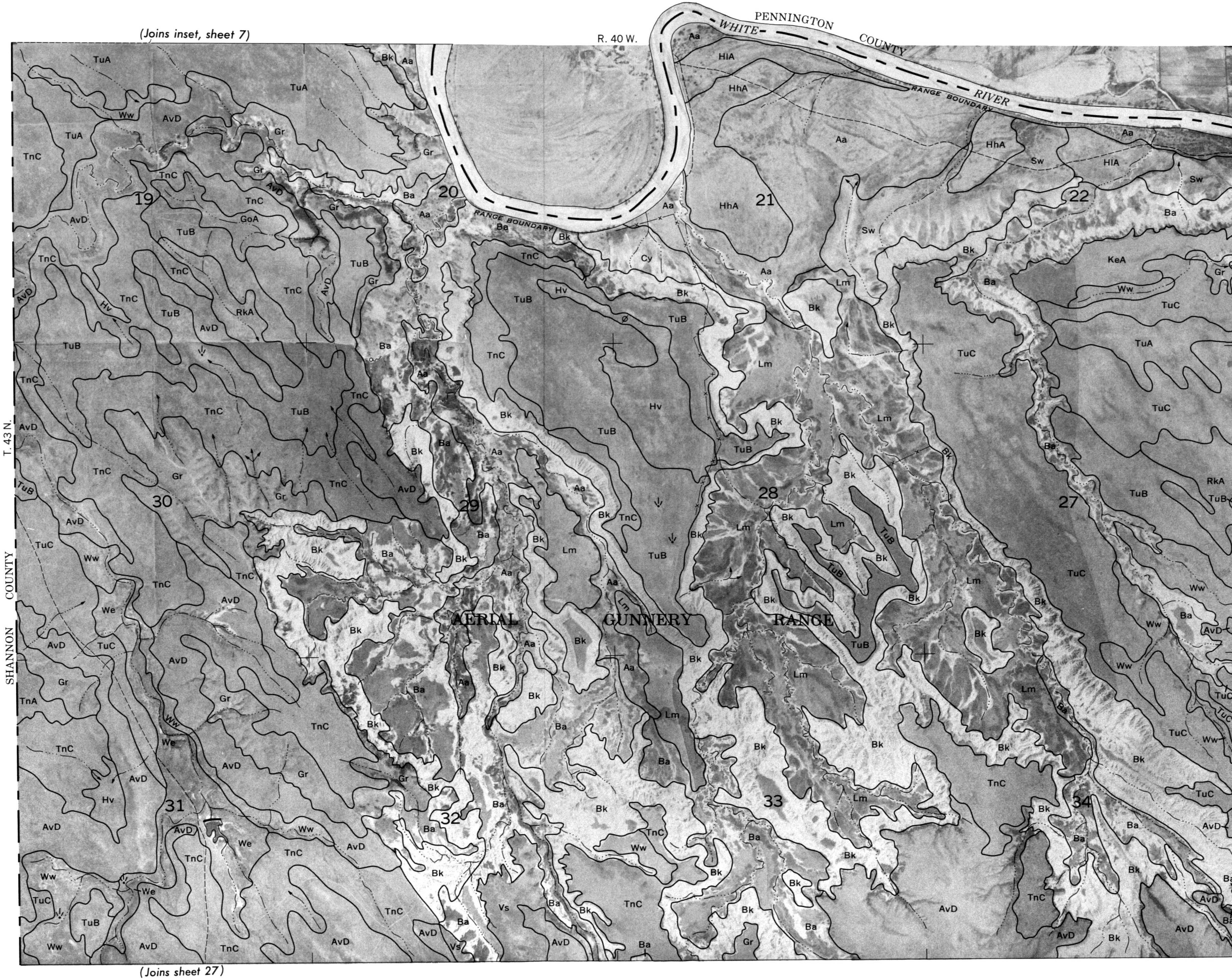
This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.

15

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 15

5 000 Feet
0
Scale 1:20 000
1 Mile
½
0



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 16

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.

17

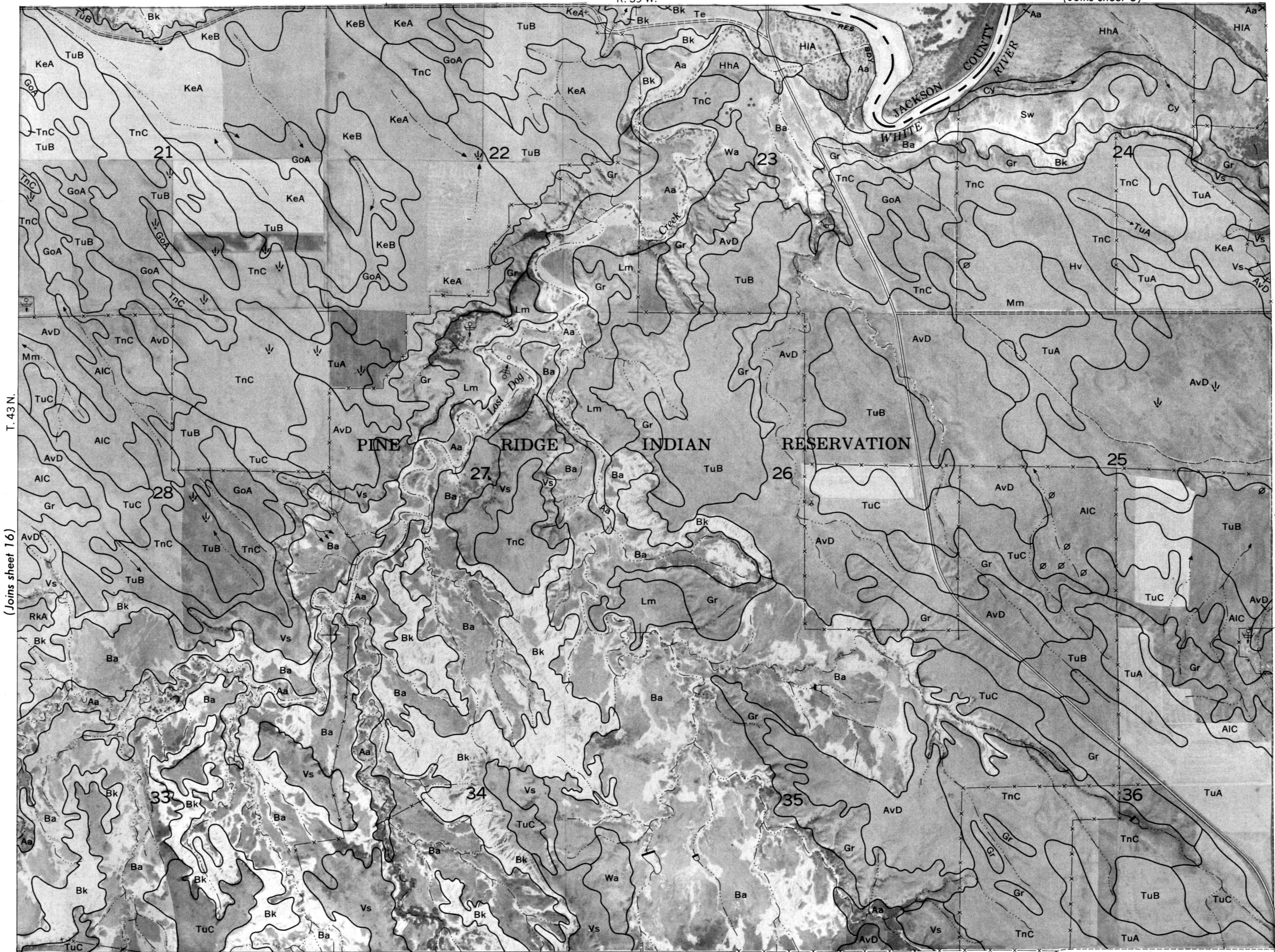
R. 39 W.

(Joins sheet 8)

T. 43 N.

(Joins sheet 16)

(Joins sheet 18)

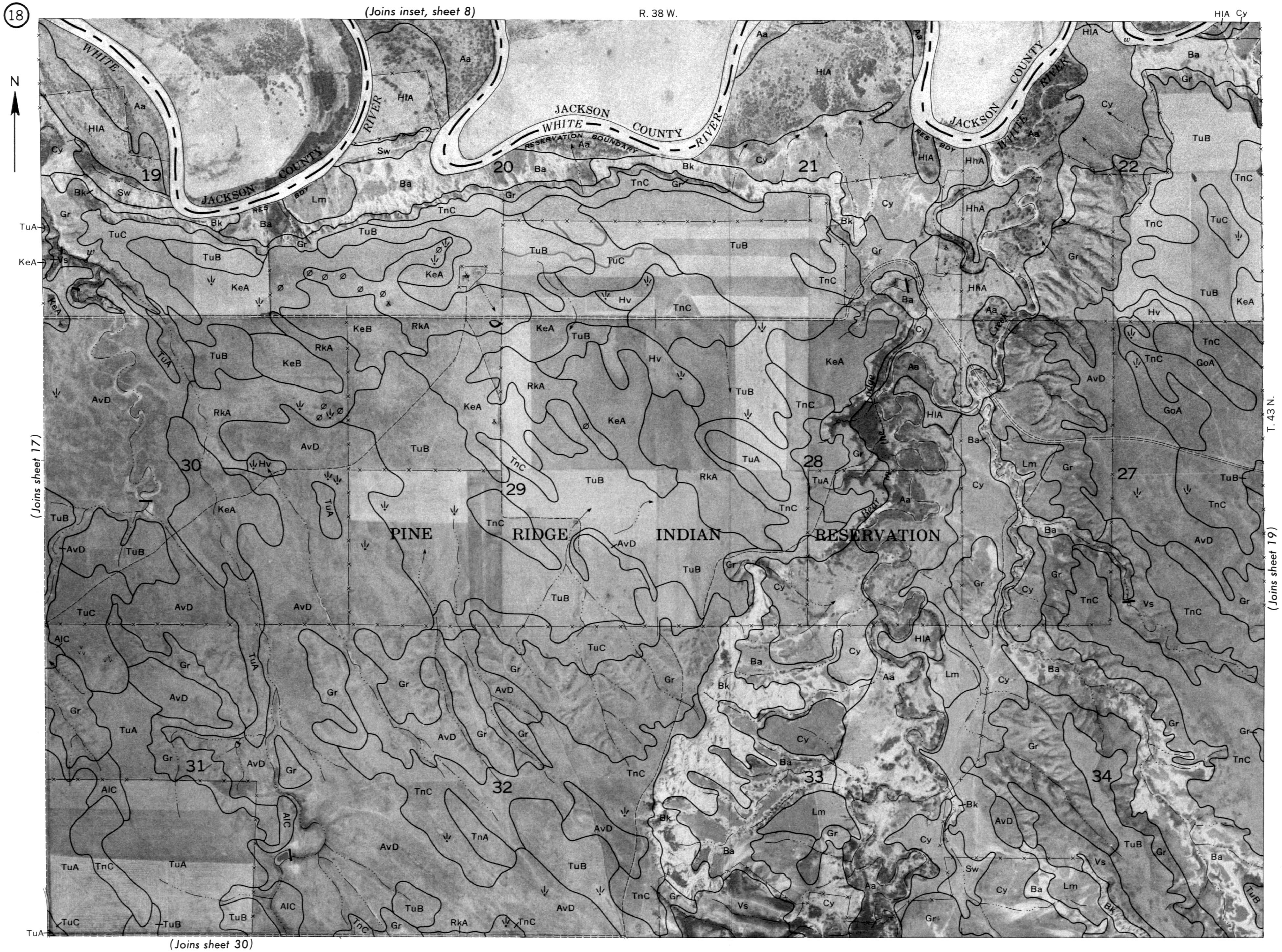


(Joins sheet 29)

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 17



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 18

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.

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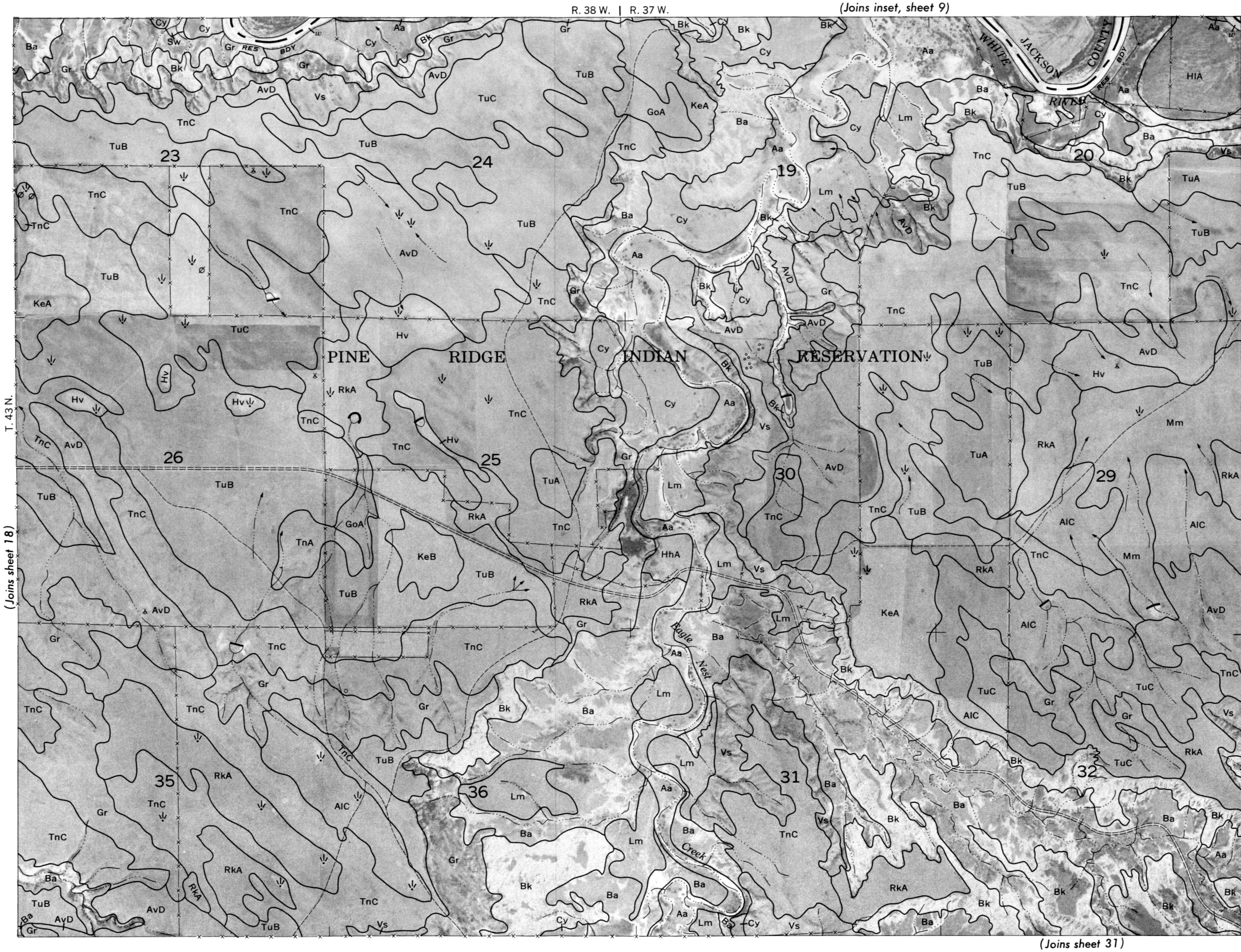
Land division corners are approximately positioned on this map.

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 19



0 ½ 1 Mile
Scale 1:20 000
0 5 000 Feet

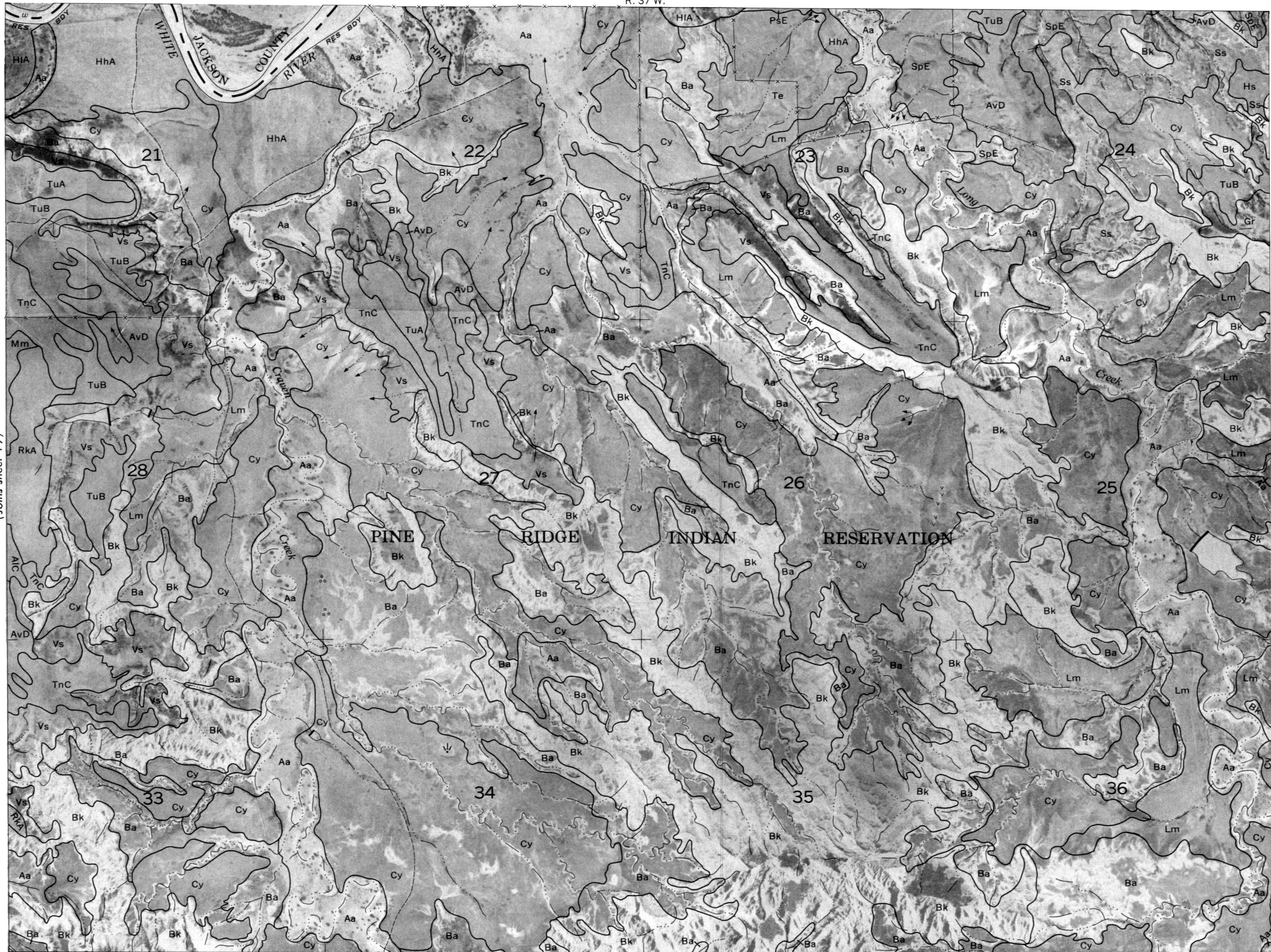
20

(Joins sheet 9)

R. 37 W.

N

(Joins sheet 19)



T. 43 N.

(Joins sheet 21)

(Joins sheet 32)

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 20

Land division corners are approximately positioned on this map.

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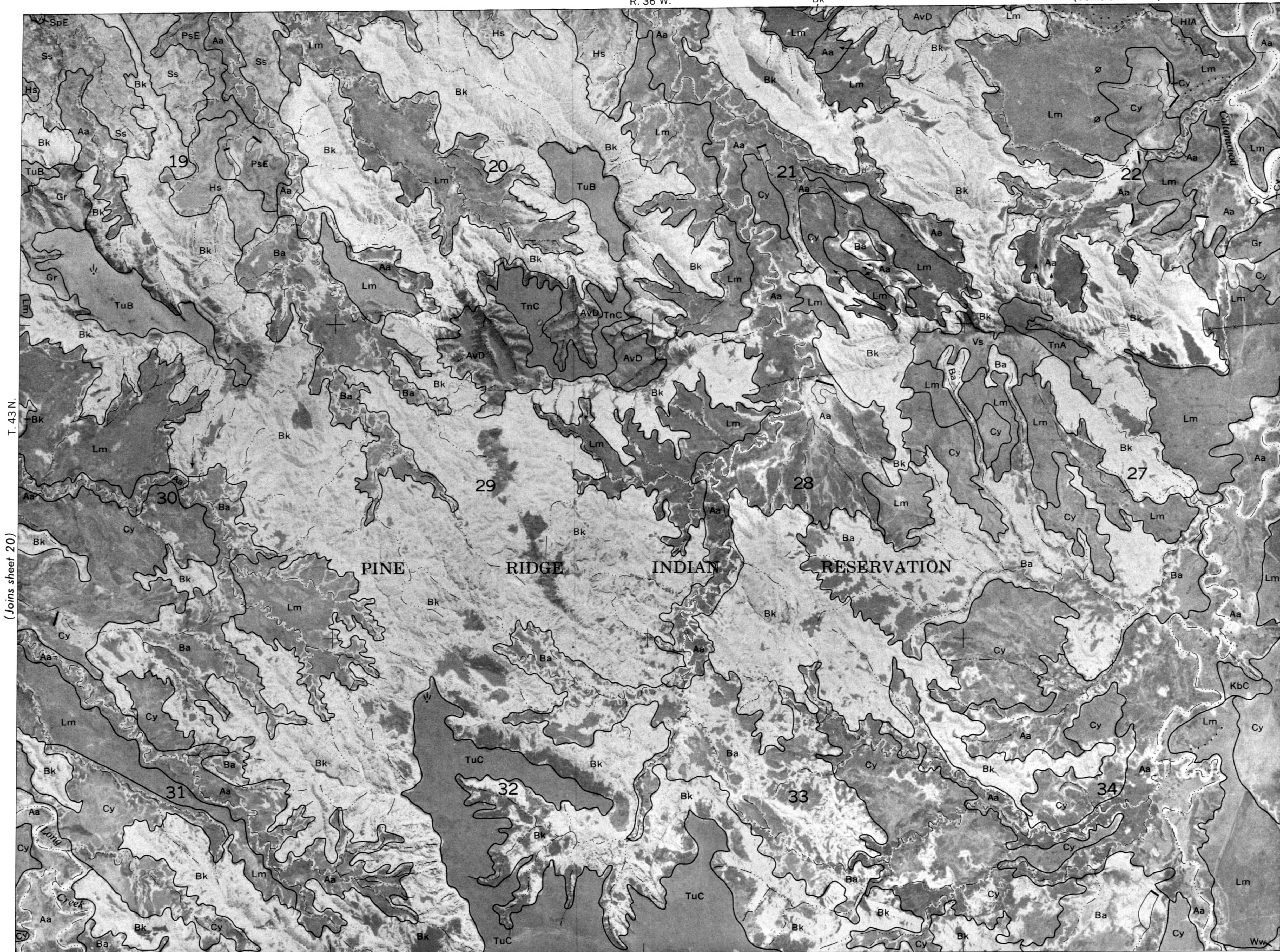
Land division corners are approximately positioned on this map.

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 21



0 ½ 1 Mile
Scale 1:20 000
0 5 000 Feet

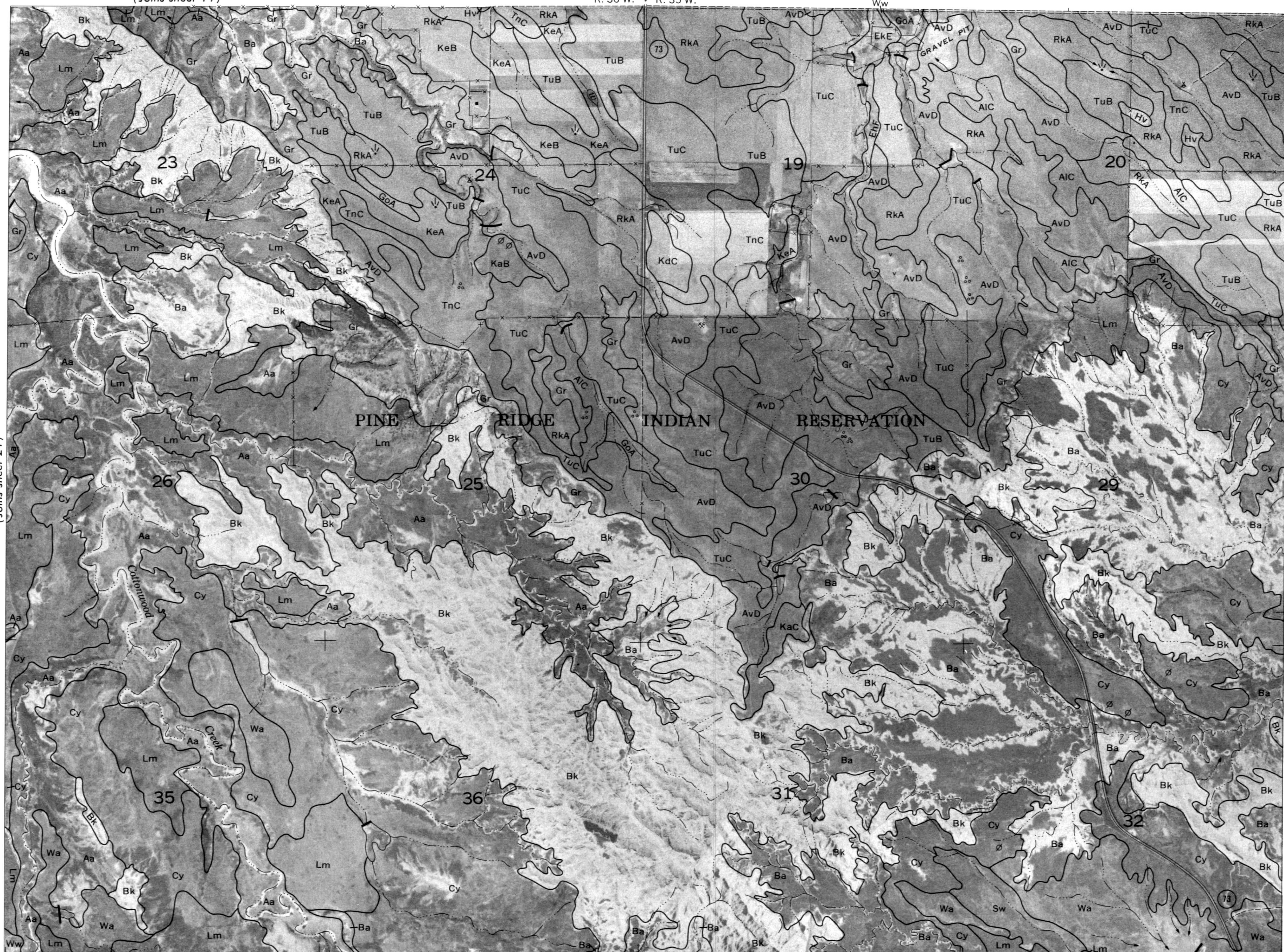
22

(Joins sheet 11)

R. 36 W. | R. 35 W.

N

(Joins sheet 21)



T. 43 N.

(Joins sheet 23)

(Joins sheet 34)

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 22

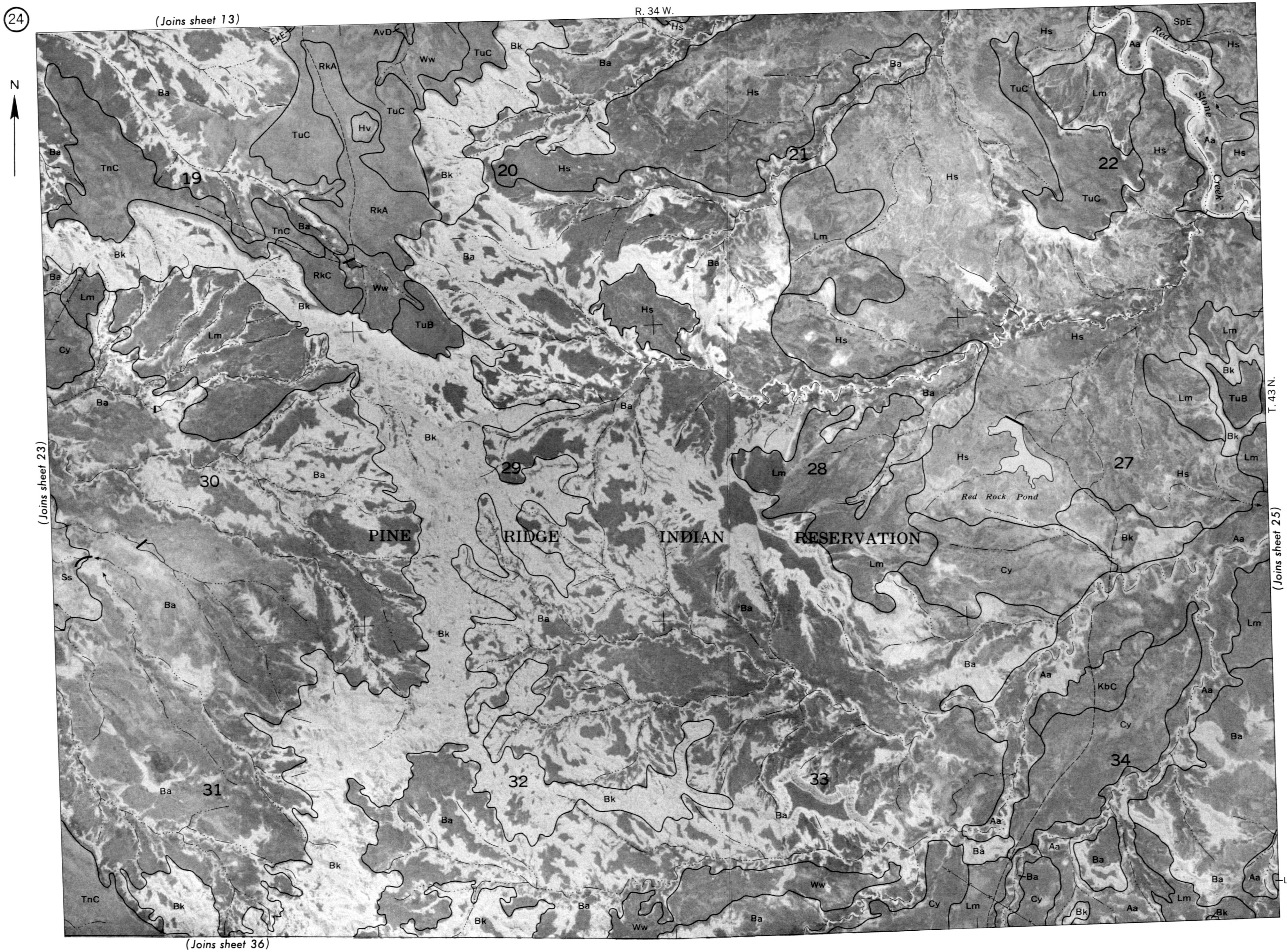
Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.

23

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.
Land division corners are approximately positioned on this map.



0 ½ 1 Mile
Scale 1:20 000
0 5 000 Feet

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 24

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.

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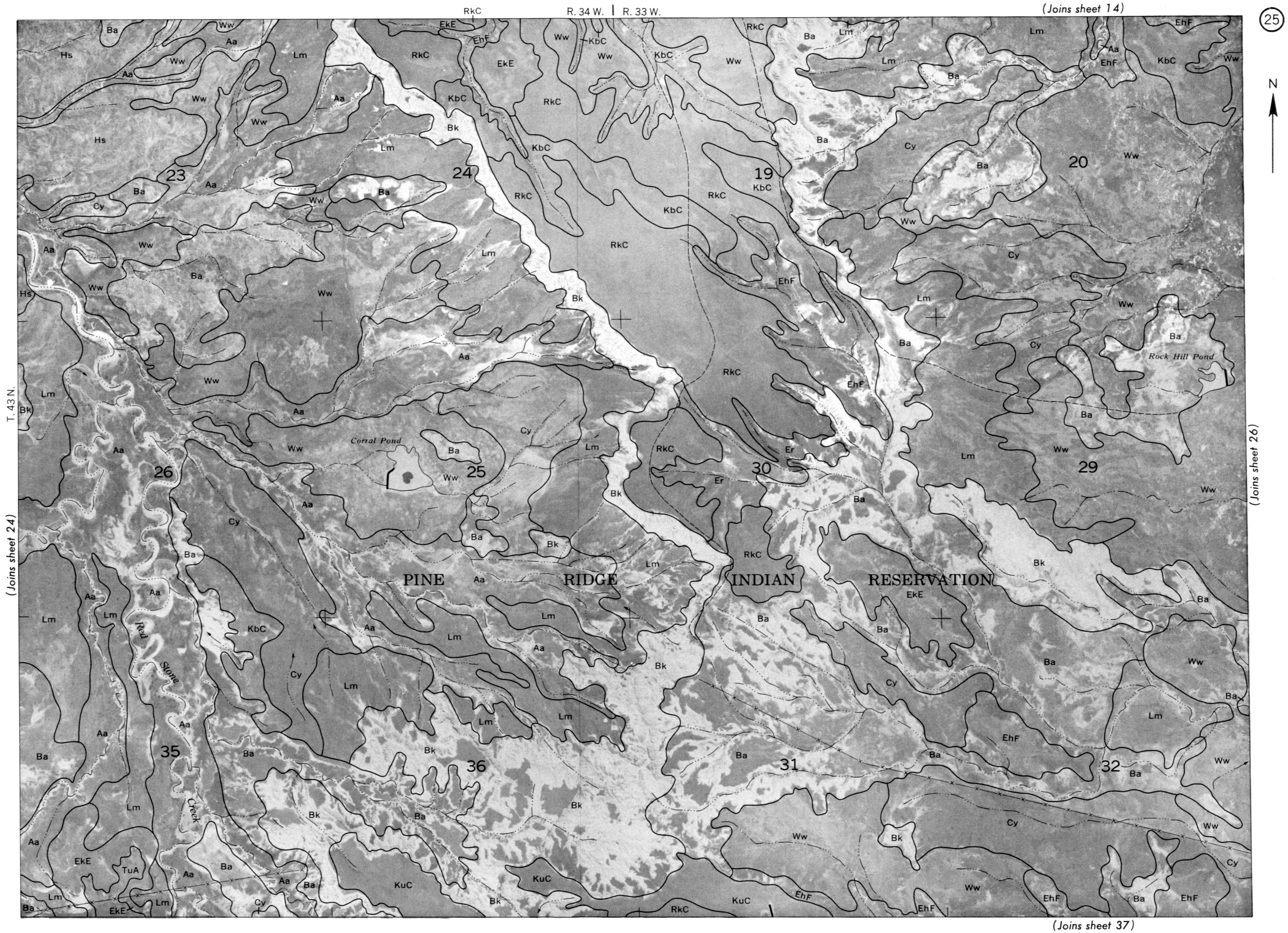
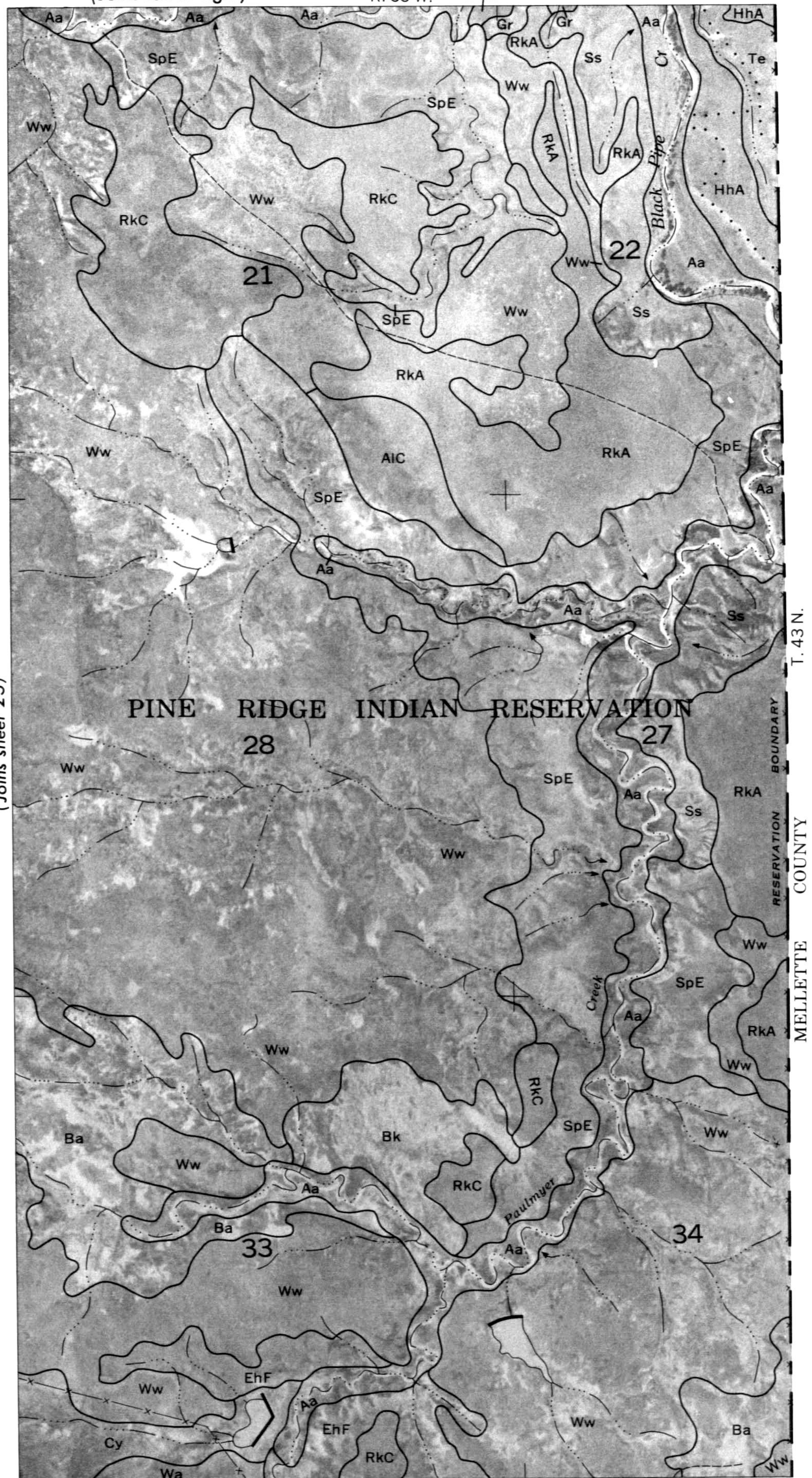
Land division corners are approximately positioned on this map.

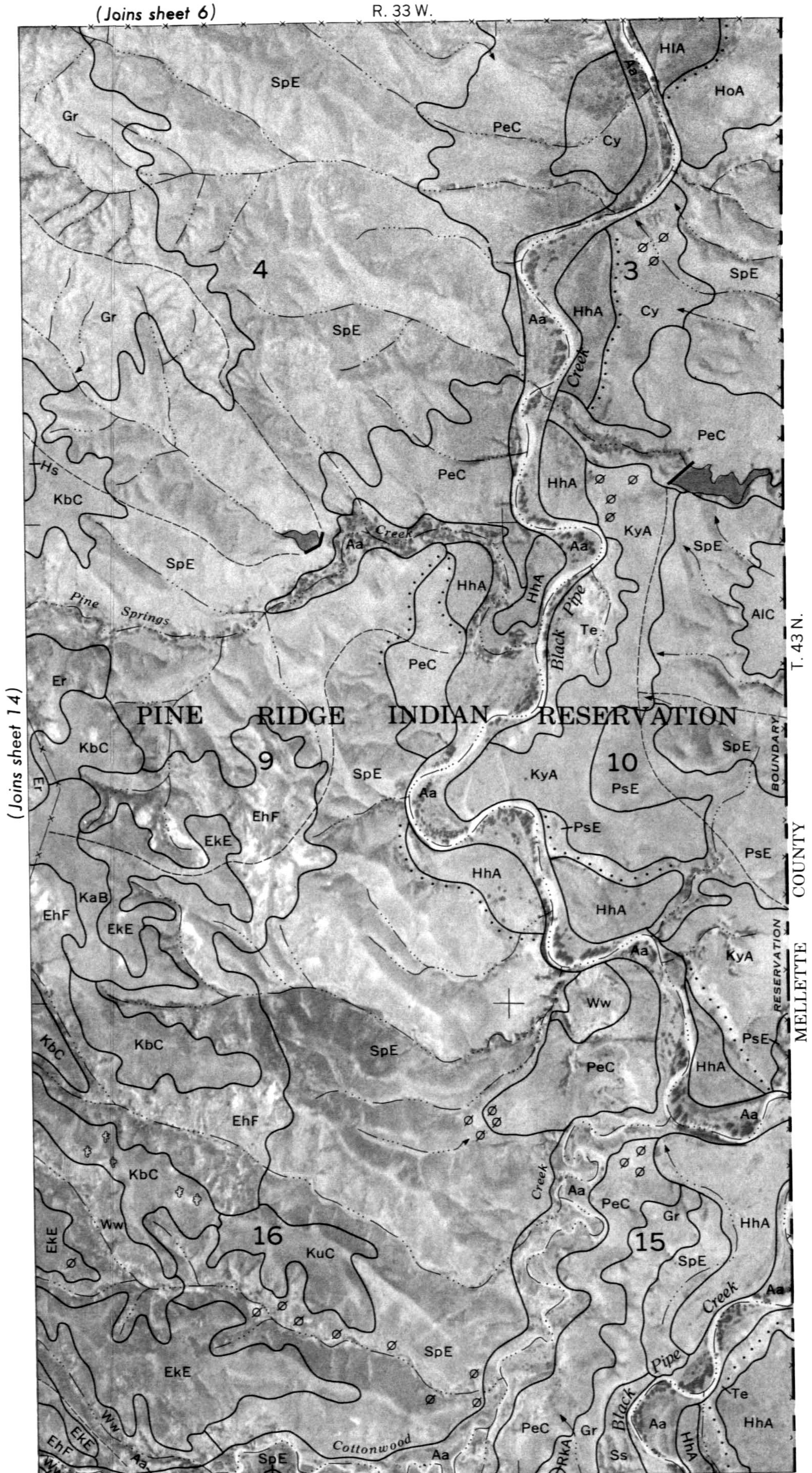
WASHABAUGH COUNTY, SOUTH DAKOTA NO. 25



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

26





0 ½ 1 Mile

Scale 1:20 000

0 5 000 Feet

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 26

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.

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Land division corners are approximately positioned on this map.

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 27

27

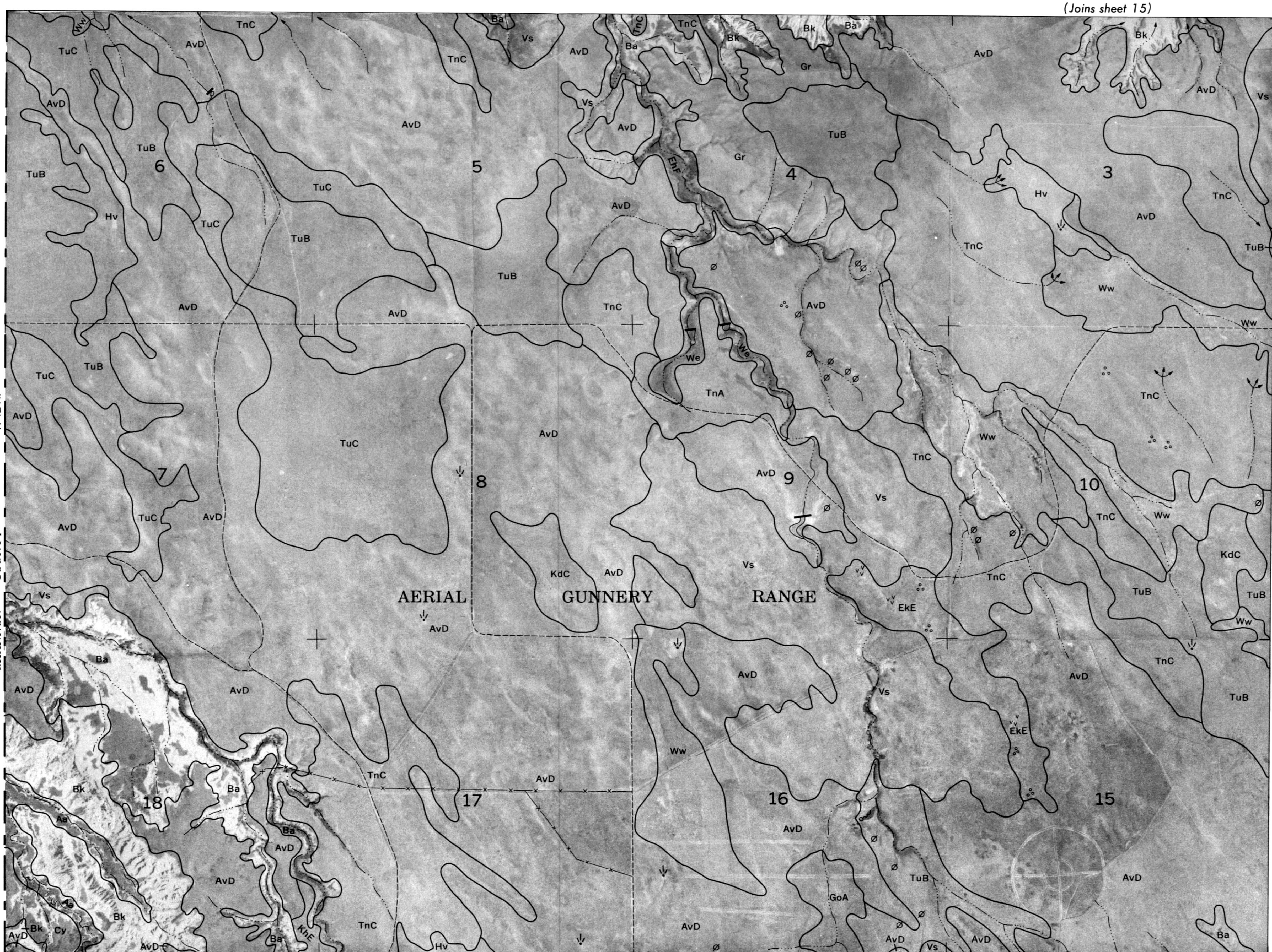
R. 40 W.

(Joins sheet 15)

N

T. 42 N.

SHANNON COUNTY



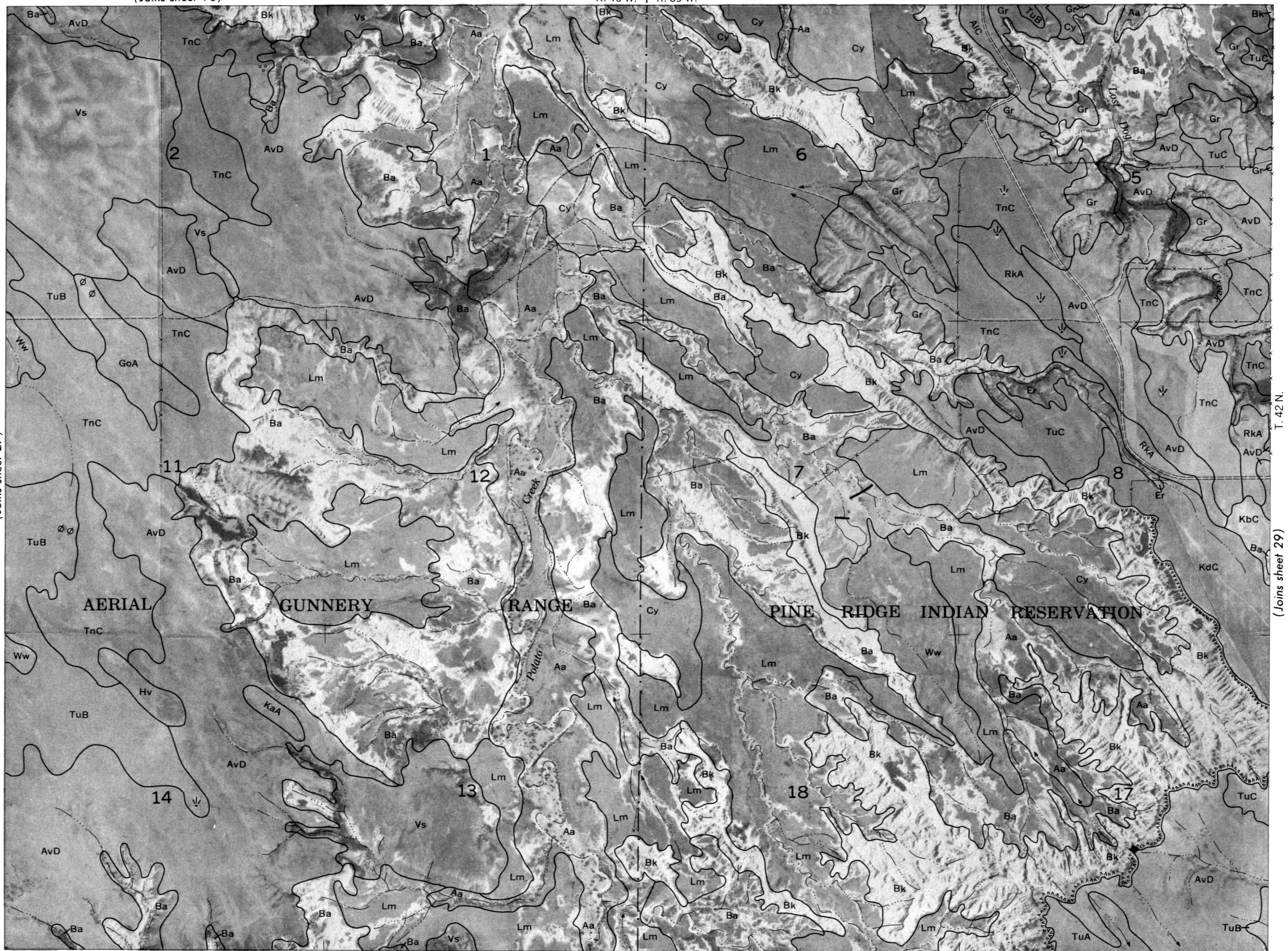
(Joins sheet 28)

(Joins sheet 38)

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

28

(Joins sheet 16)



(Joins sheet 27)

(Joins sheet 29)

(Joins sheet 39)

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 28

Land division corners are approximately positioned on this map.

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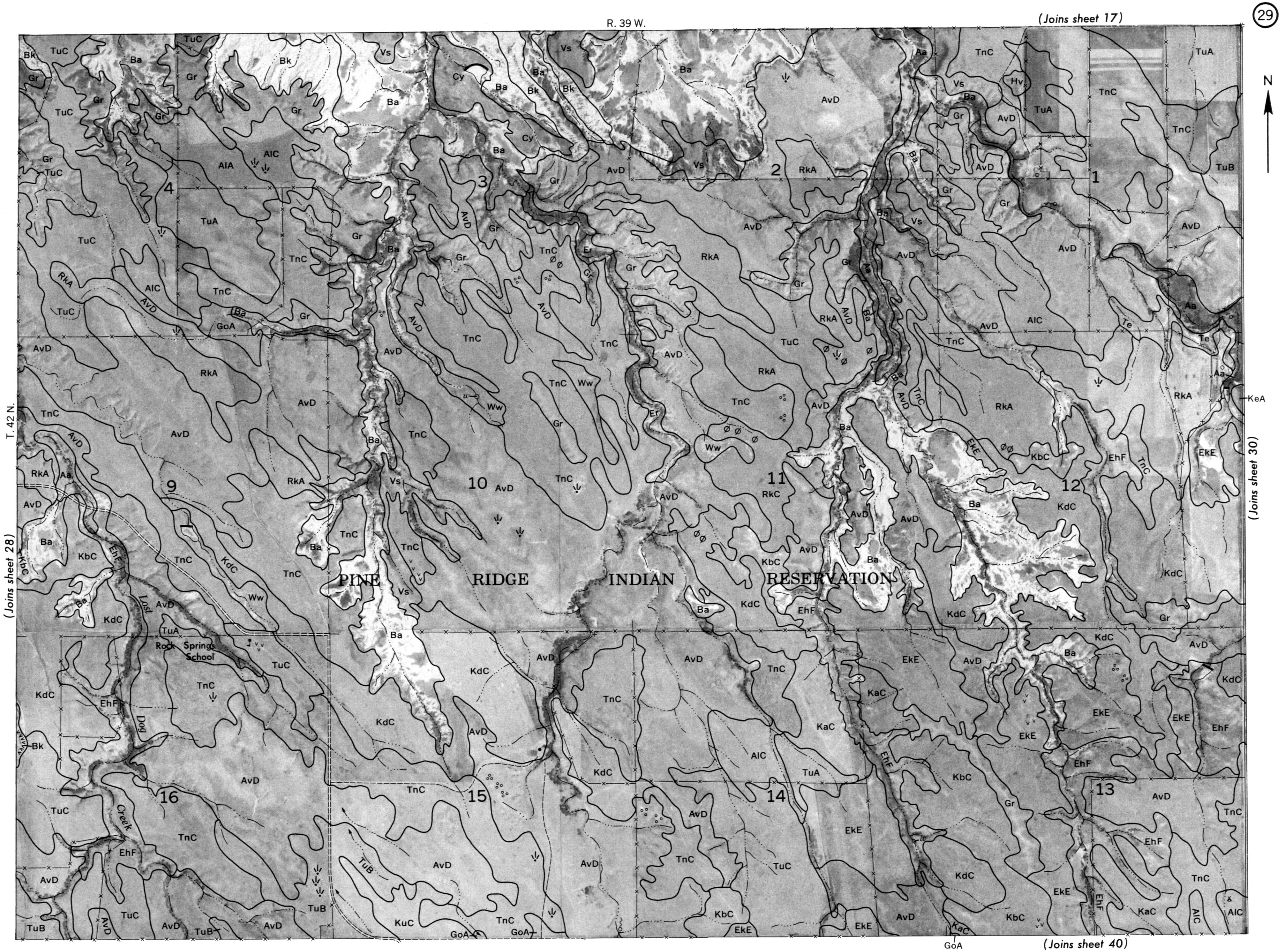


0 ½ 1 Mile

Scale 1:20 000

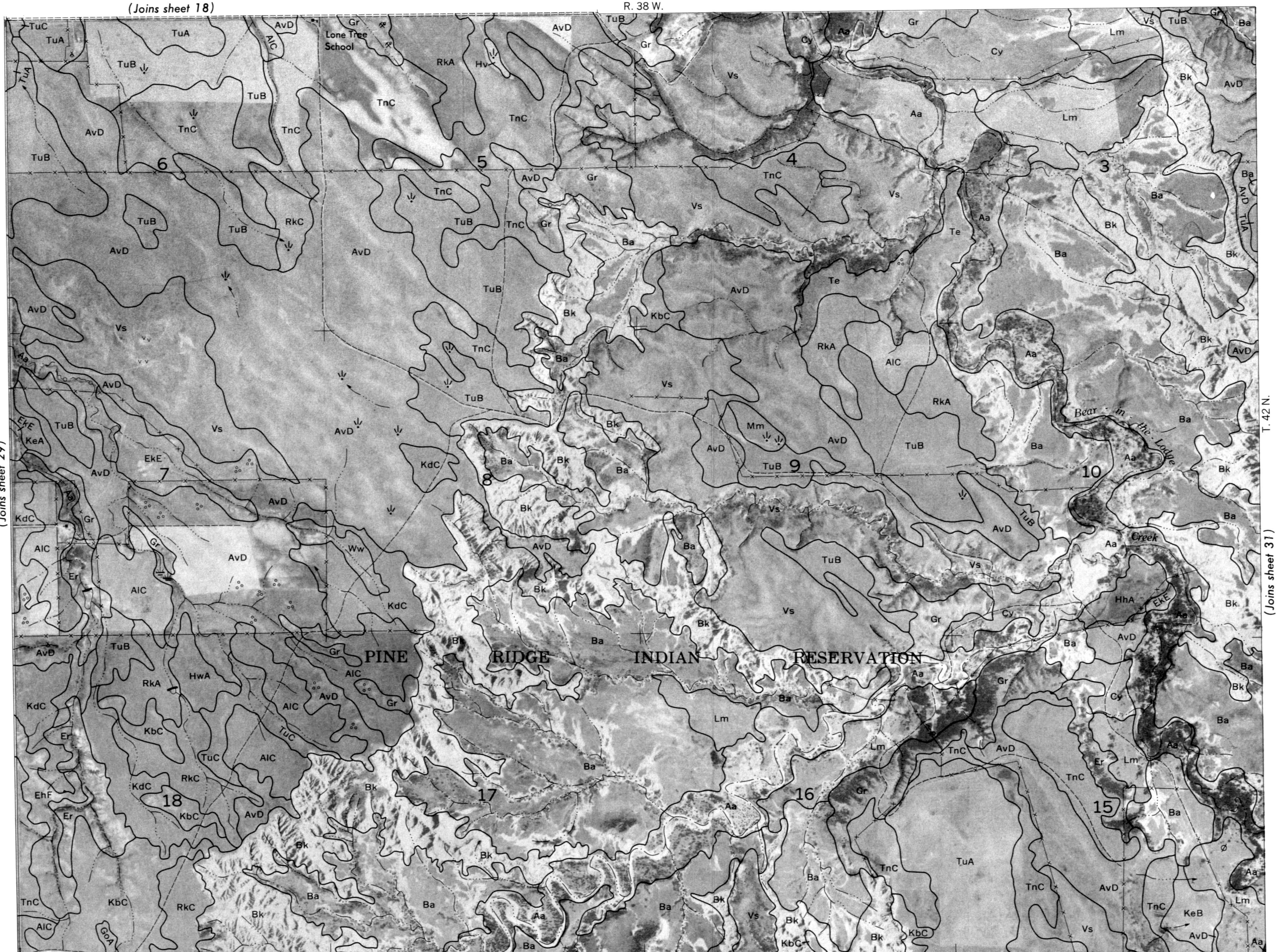
0 5 000 Feet

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 29

30

(Joins sheet 18)



(Joins sheet 29)

(Joins sheet 31)

(Joins sheet 41)

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 30

Land division corners are approximately positioned on this map.

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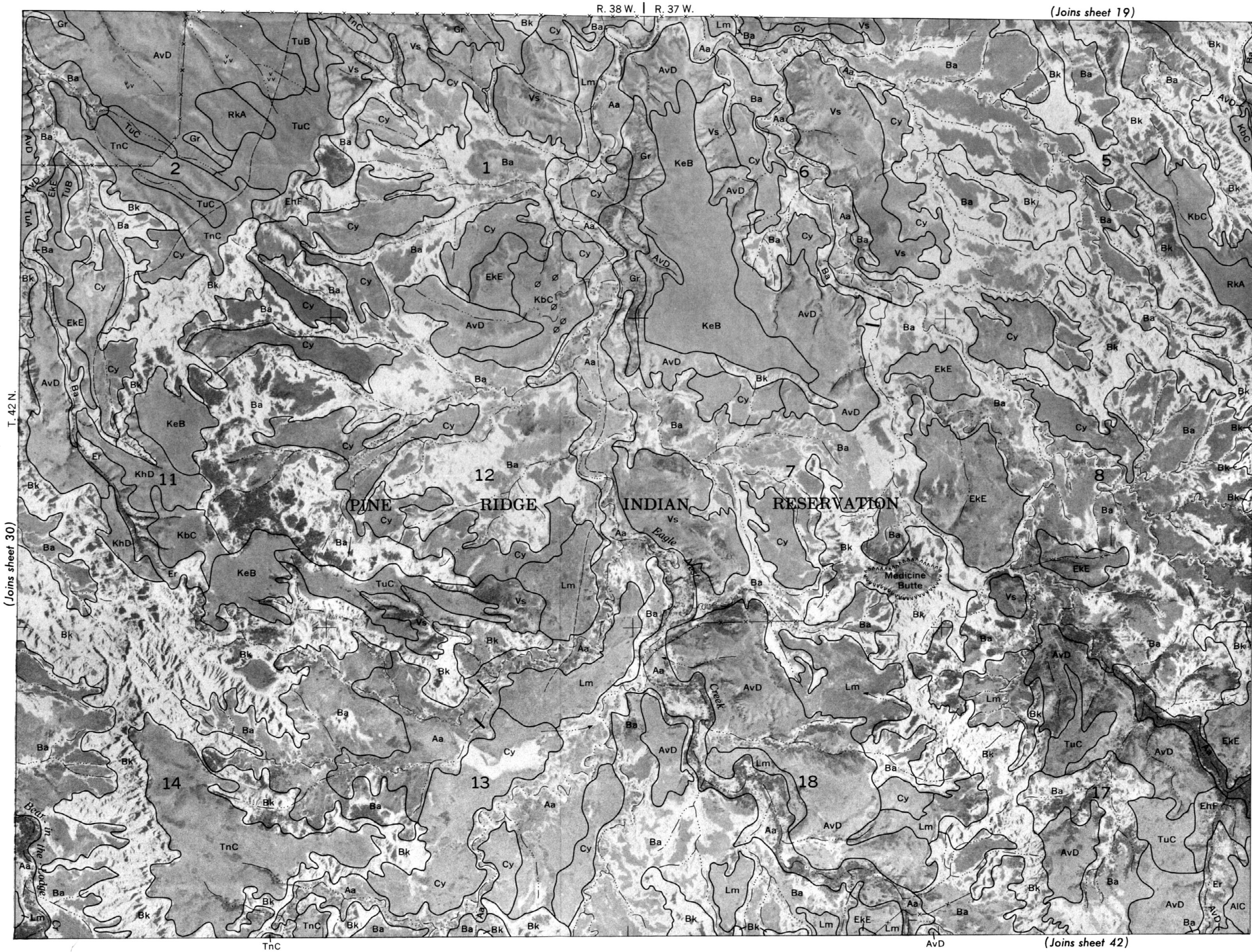
Land division corners are approximately positioned on this map.

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 31

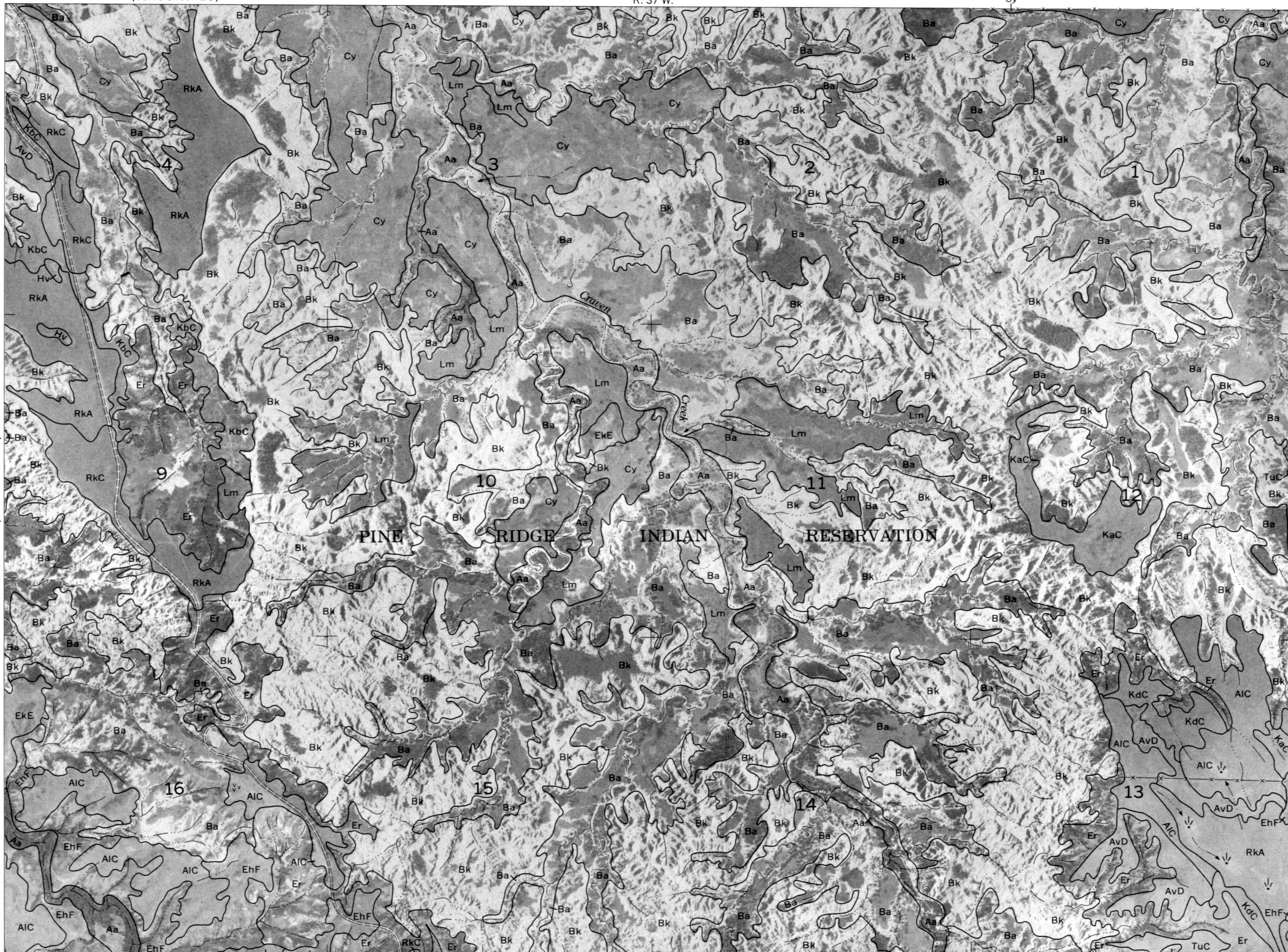


0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

32

(Joins sheet 20)

R. 37 W.



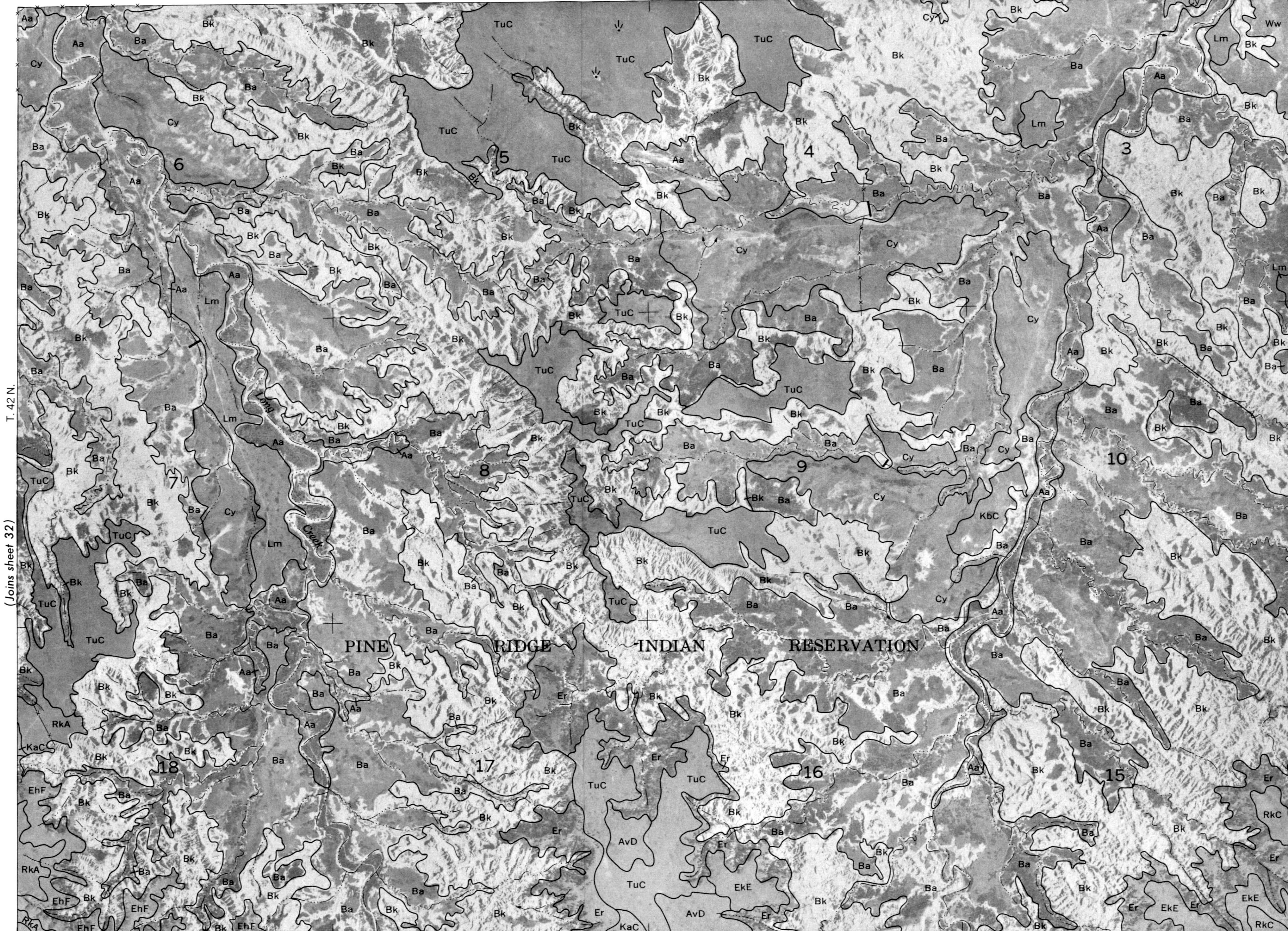
(Joins sheet 43)

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 32

Land division corners are approximately positioned on this map.

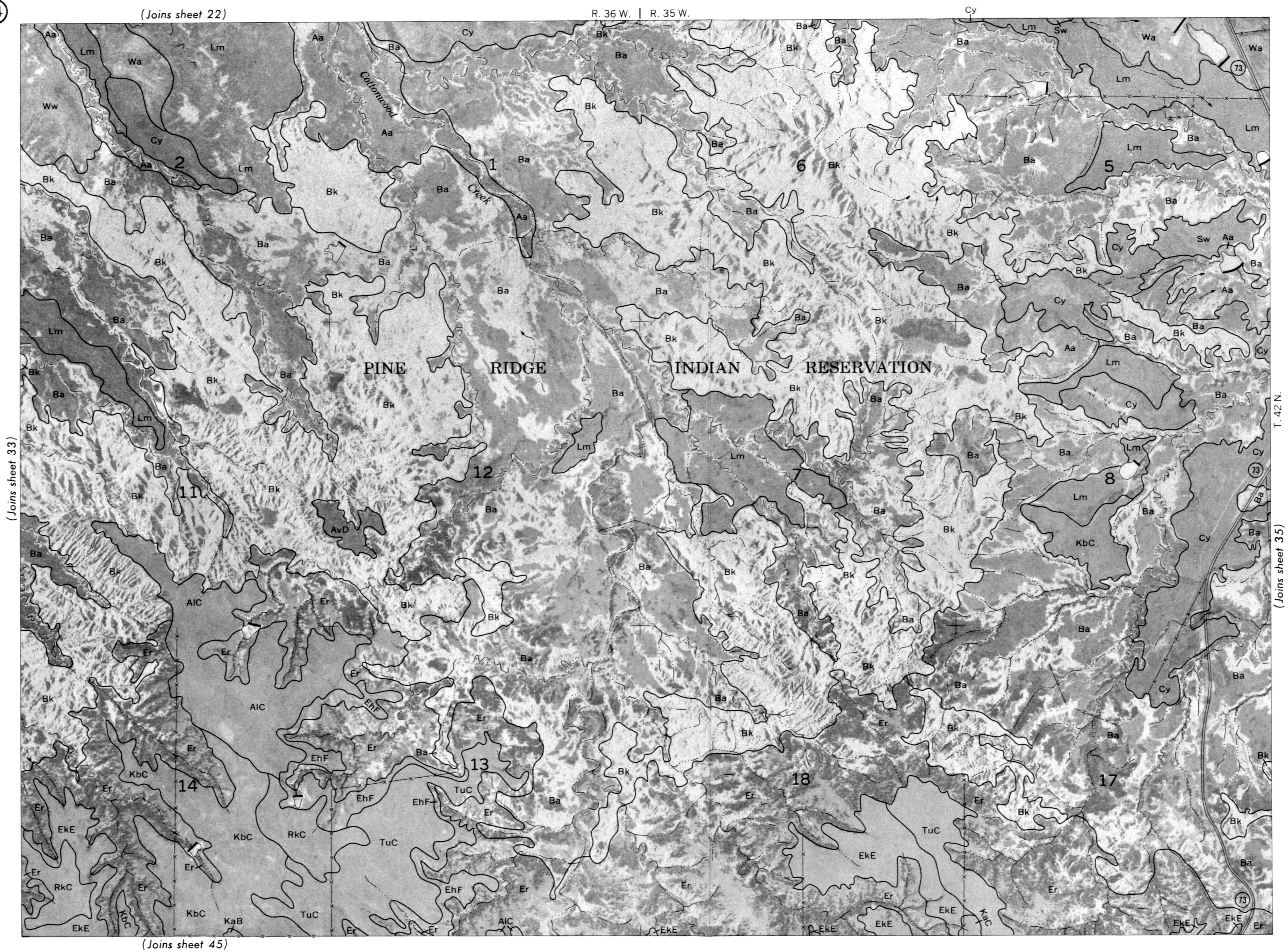
This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

34

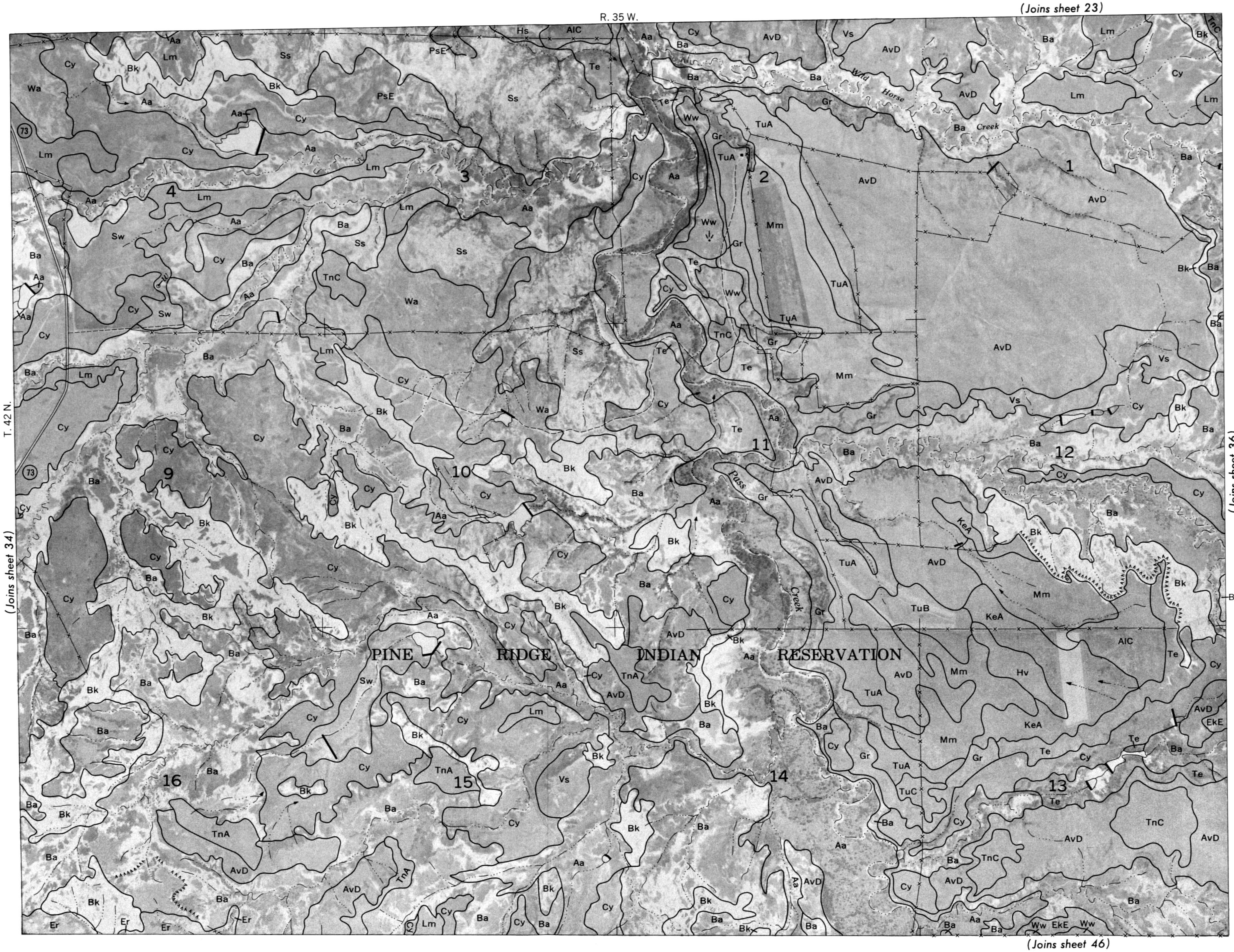


0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 34

Land division corners are approximately positioned on this map.

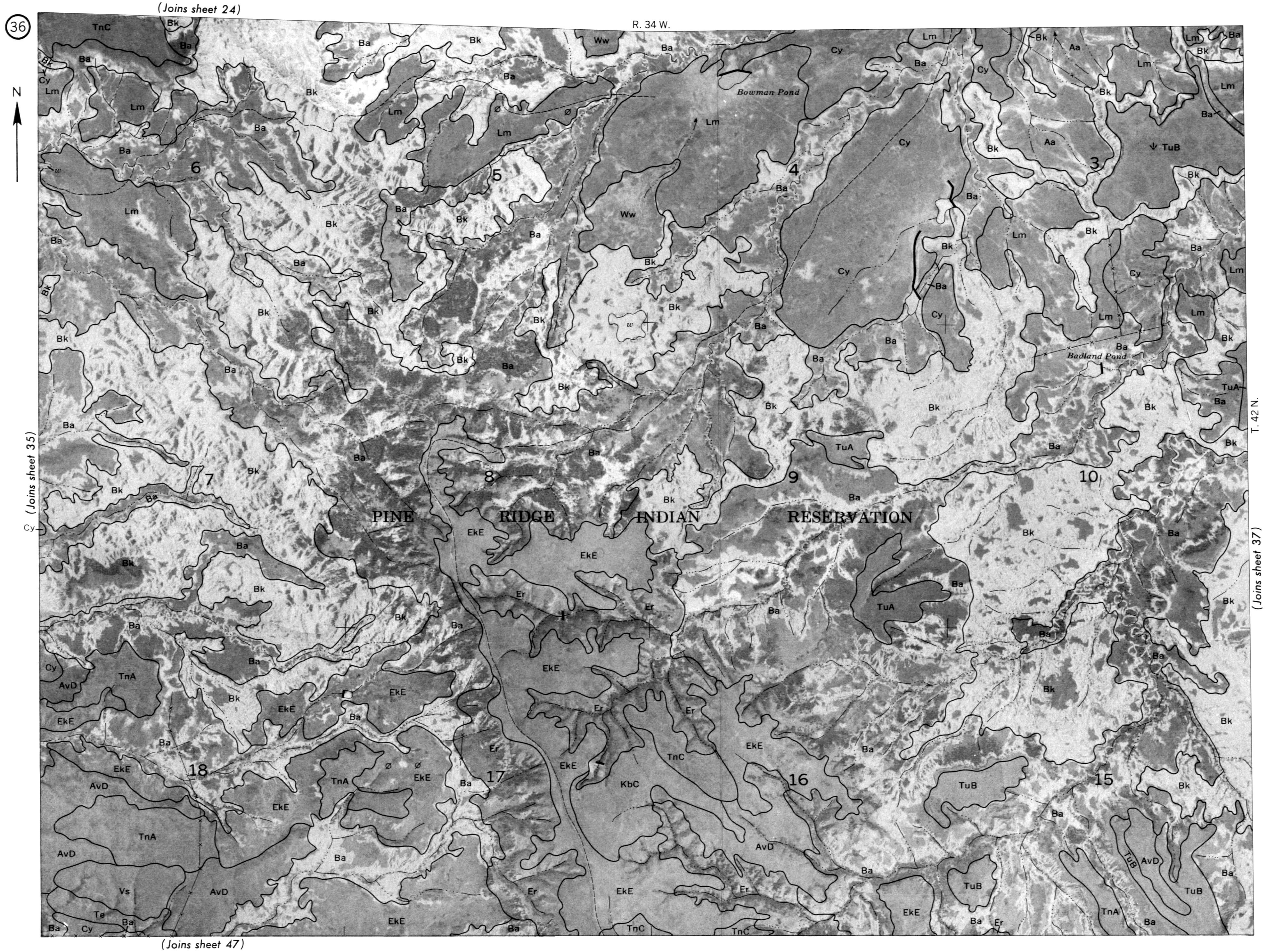
This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 35

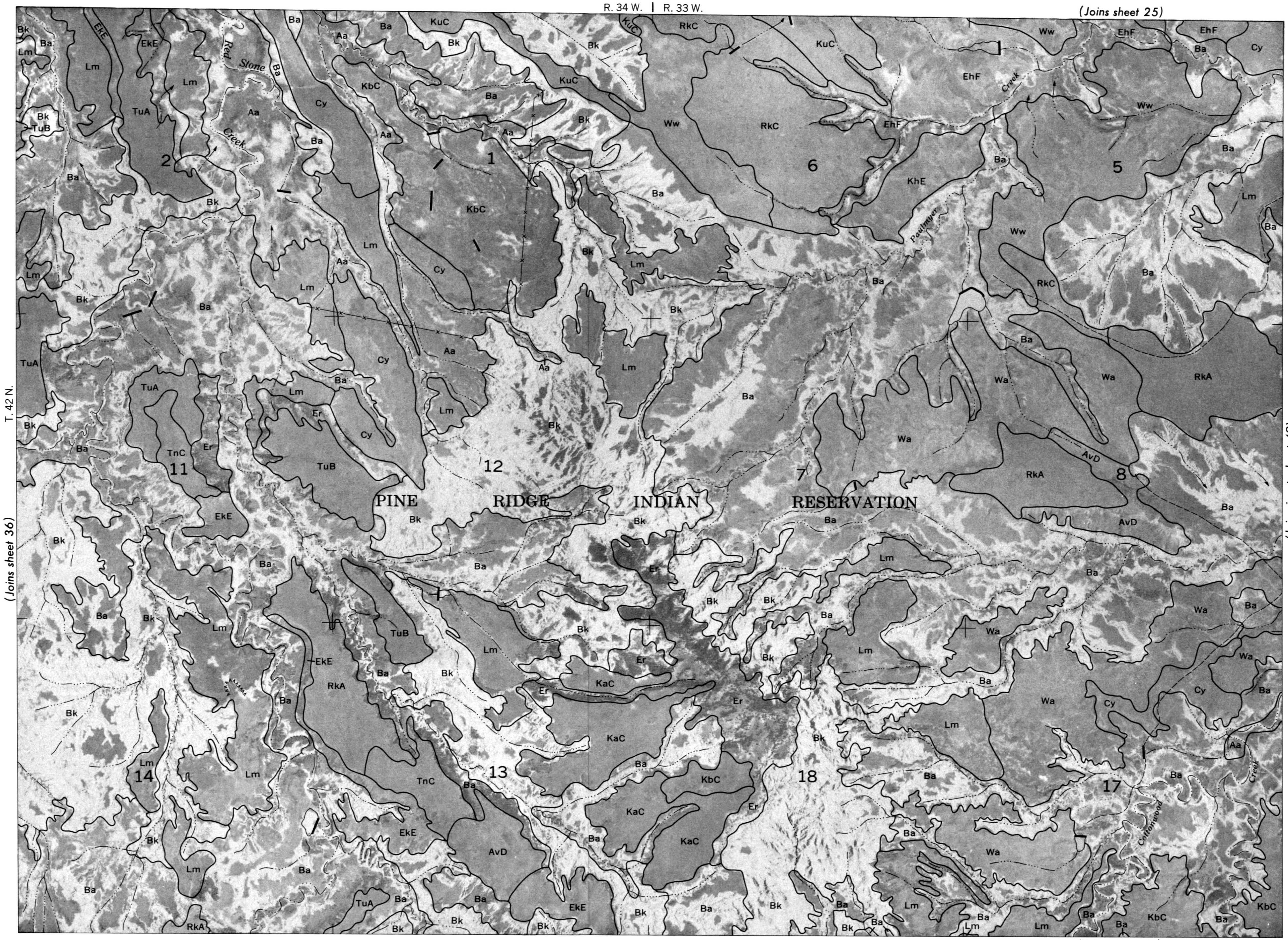


0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 36

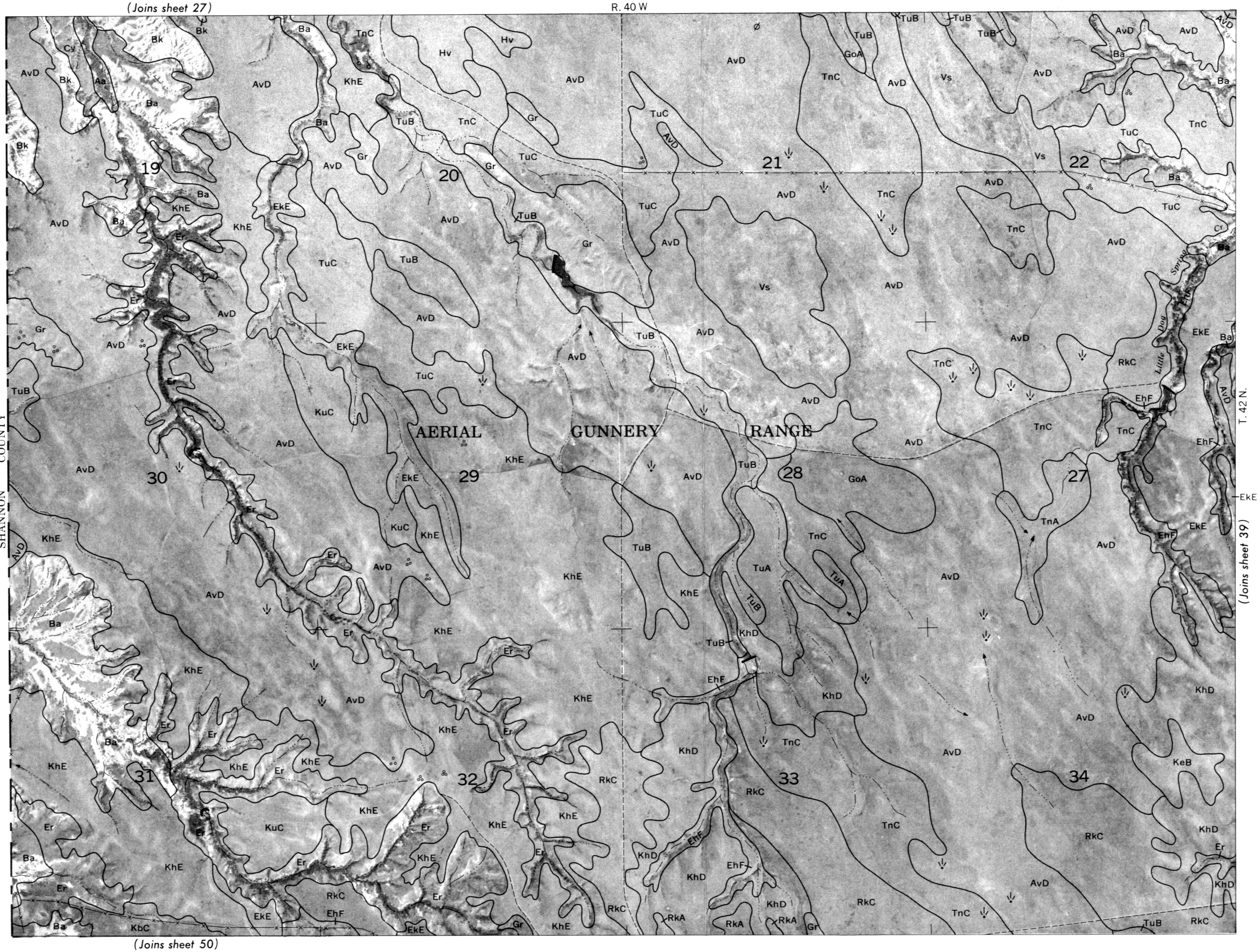
Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.



0 ½ 1 Mile
Scale 1:20 000
0 5 000 Feet

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.
Land division corners are approximately positioned on this map.



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 38

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.

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Land division corners are approximately positioned on this map.

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 39

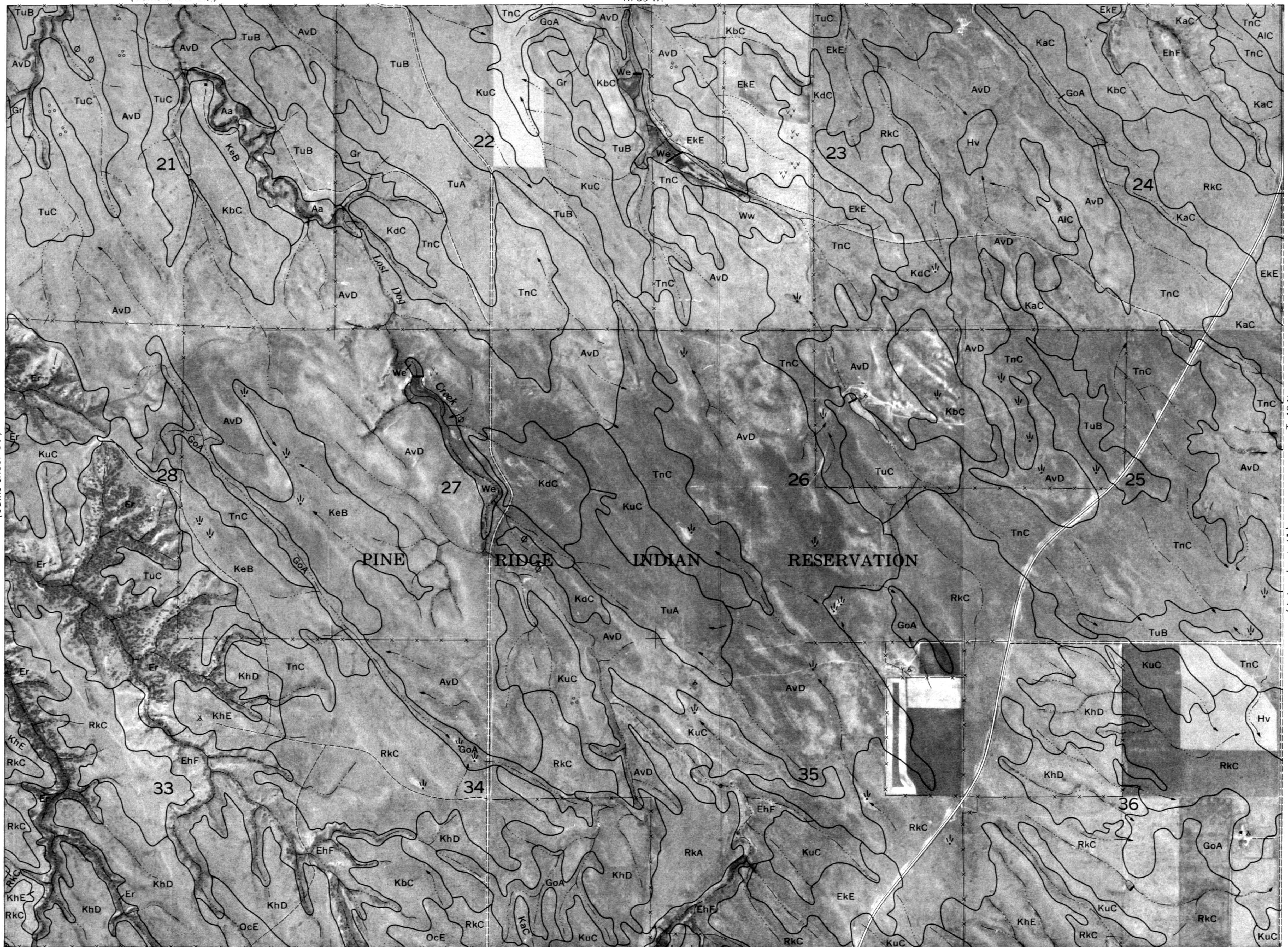
0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

40

(Joins sheet 29)

R. 39 W.

N



(Joins sheet 39)

(Joins sheet 41)

(Joins sheet 52)

OcE

KuC OcE

0 ½ 1 Mile

Scale 1:20 000

0 5 000 Feet

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 40

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.

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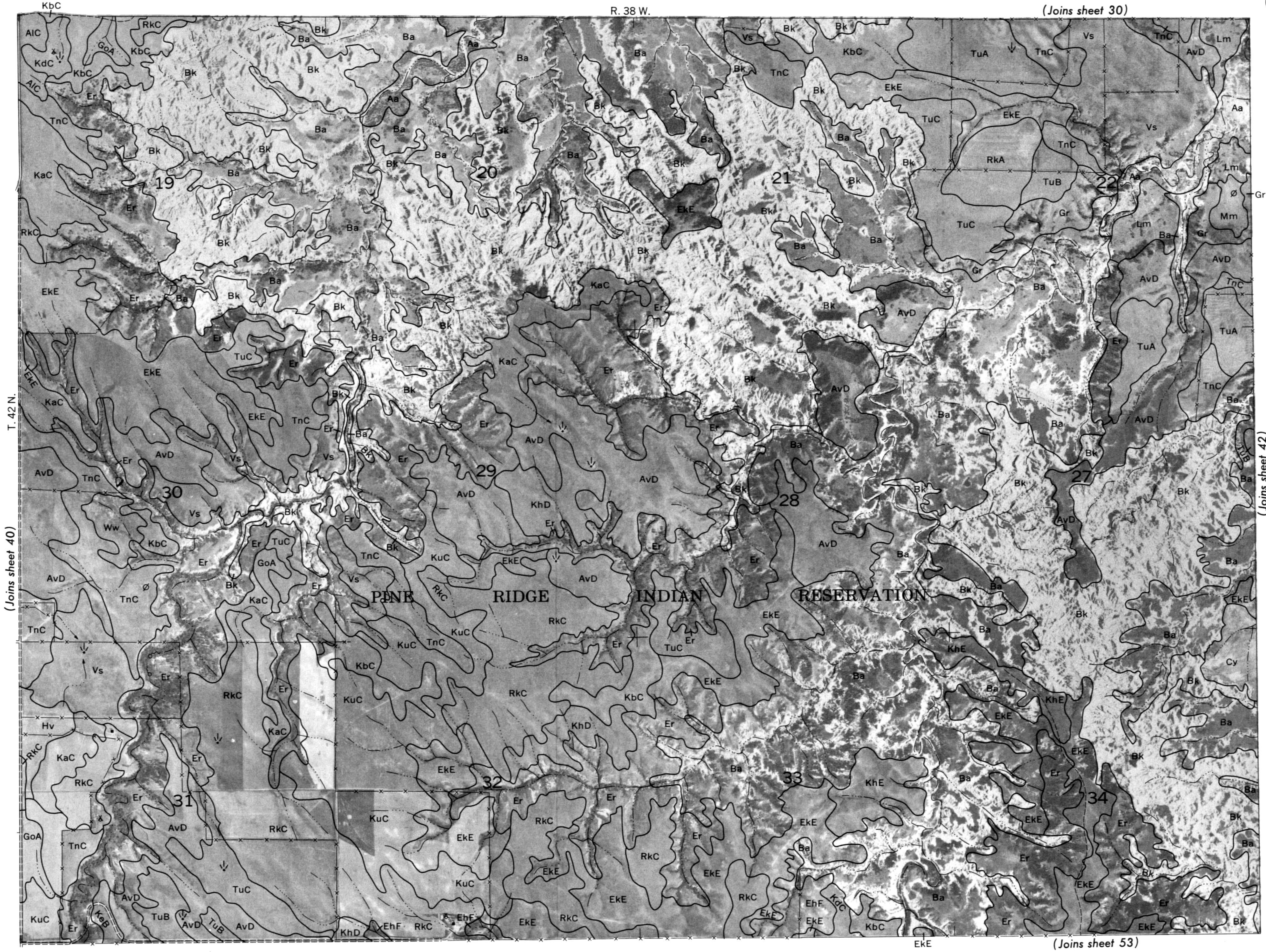
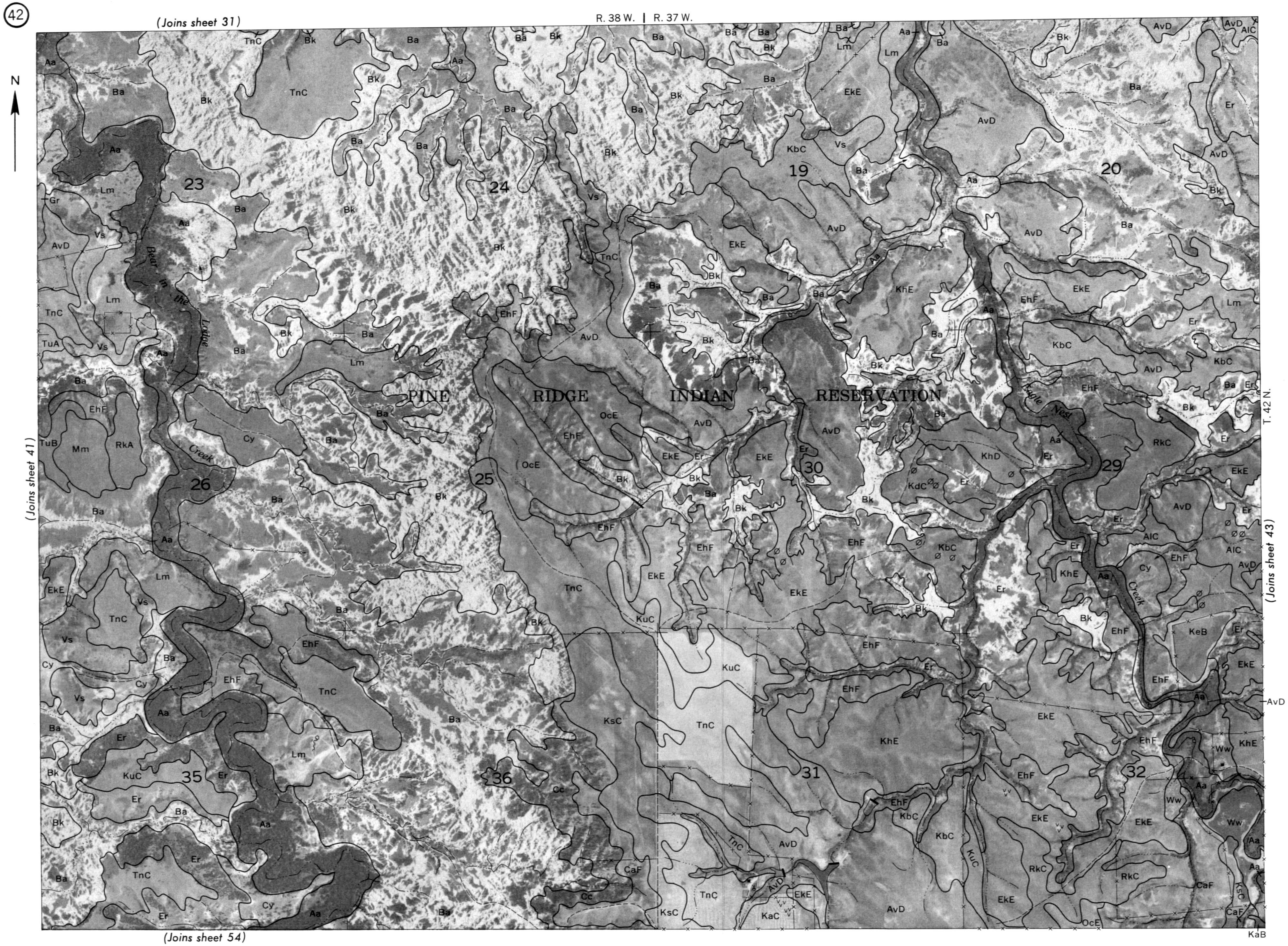
Land division corners are approximately positioned on this map.

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 41



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

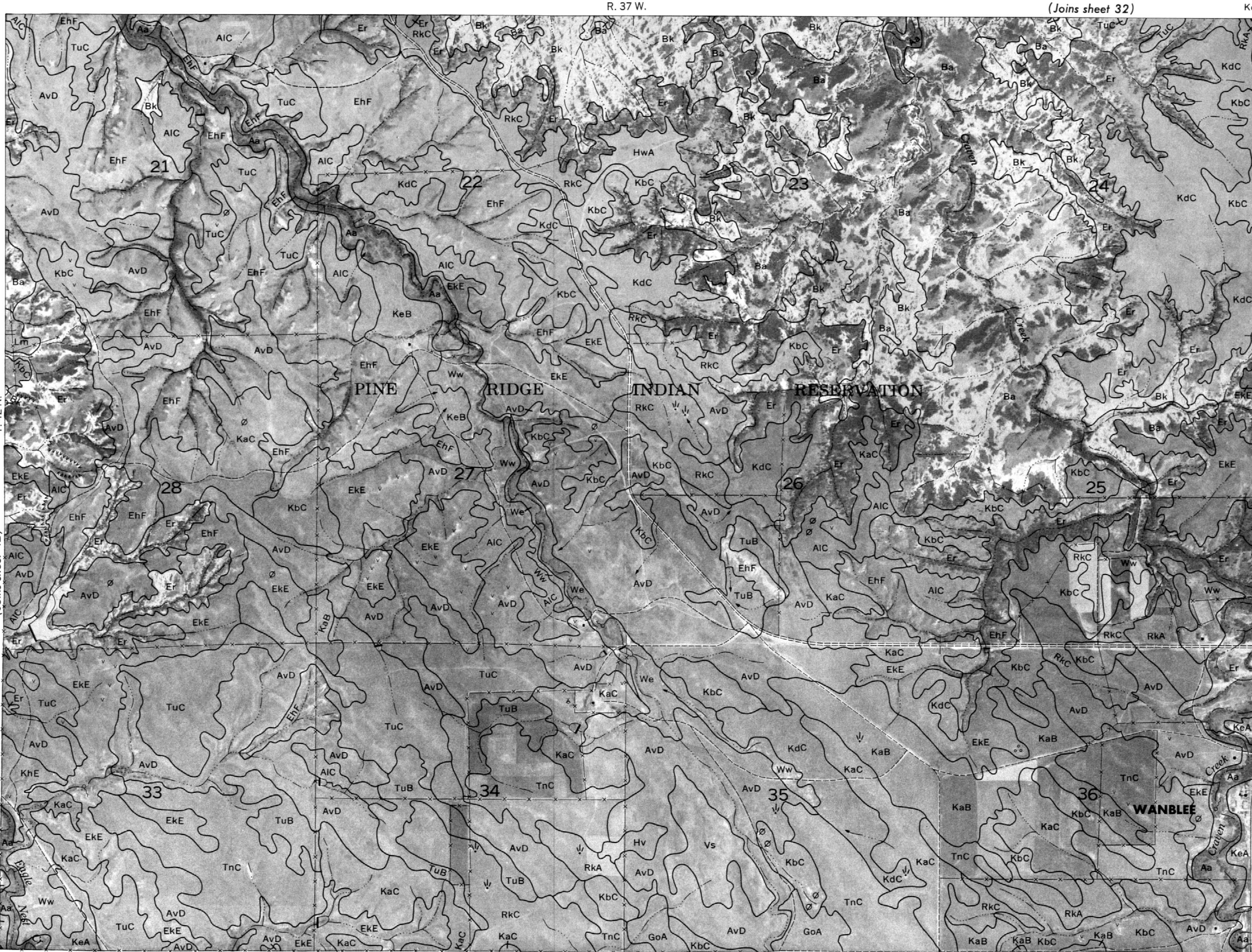


0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 42

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

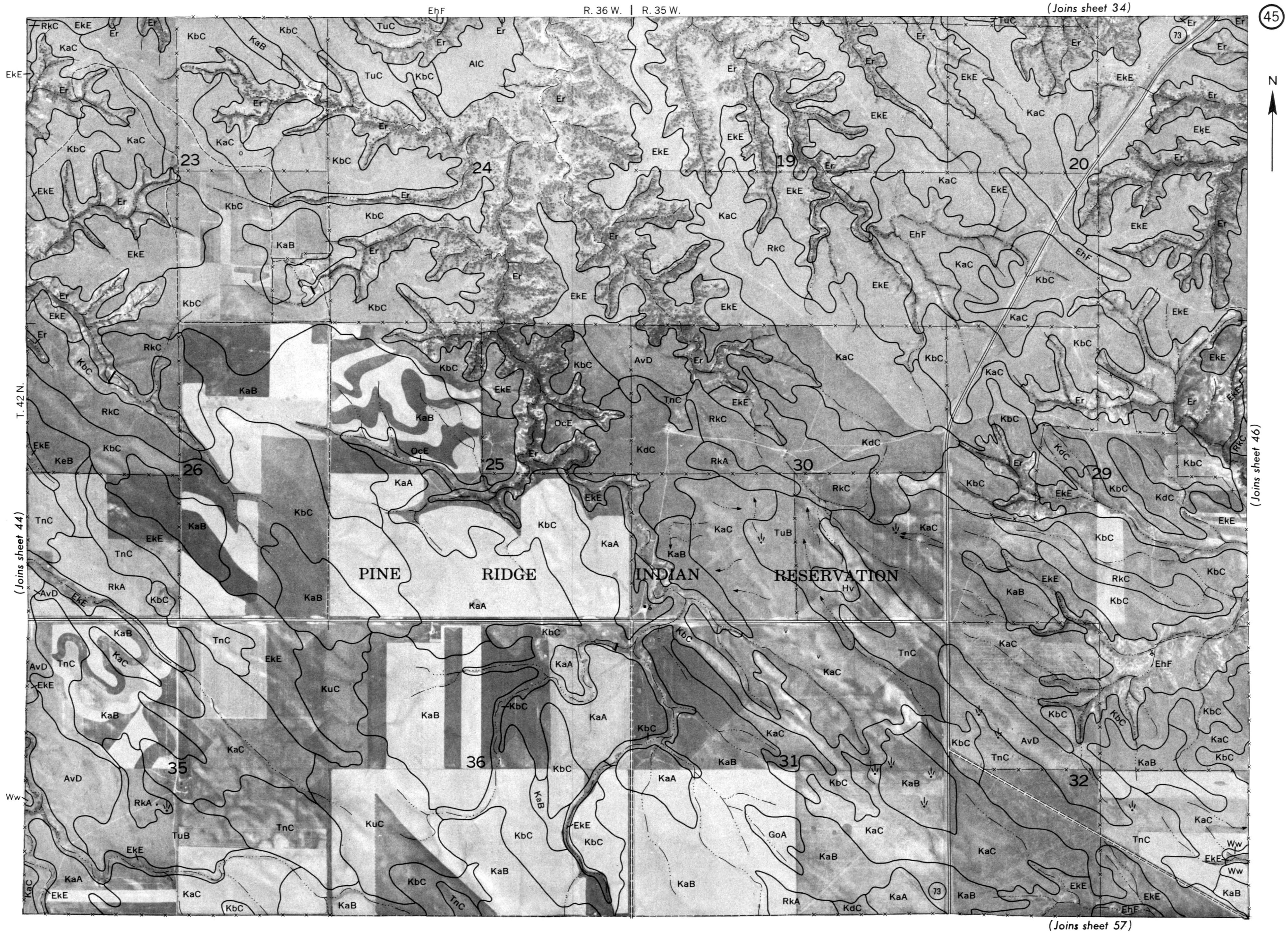
WASHABAUGH COUNTY, SOUTH DAKOTA NO. 43

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 44

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

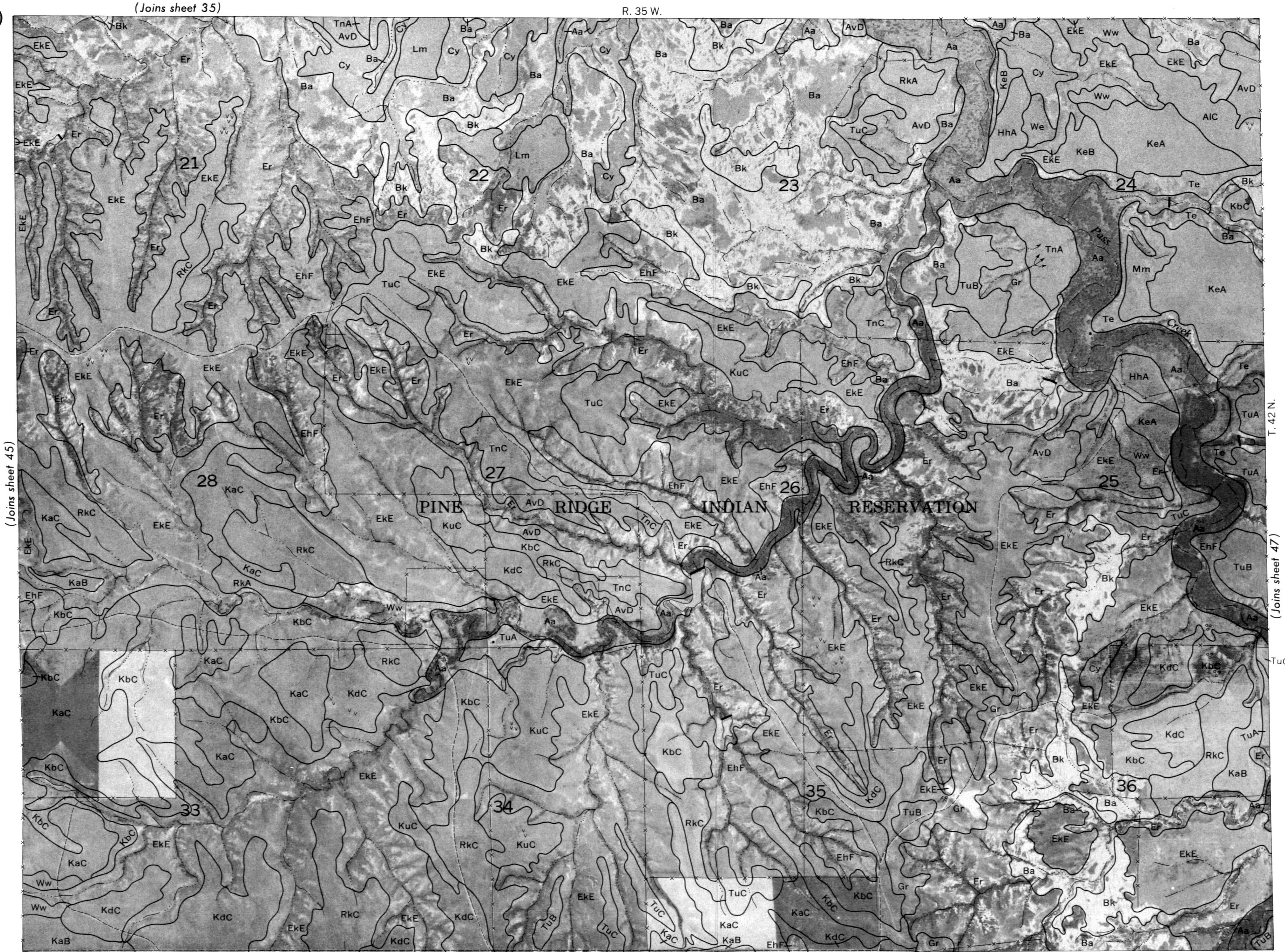
This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 45

46

(Joins sheet 35)

R. 35 W.



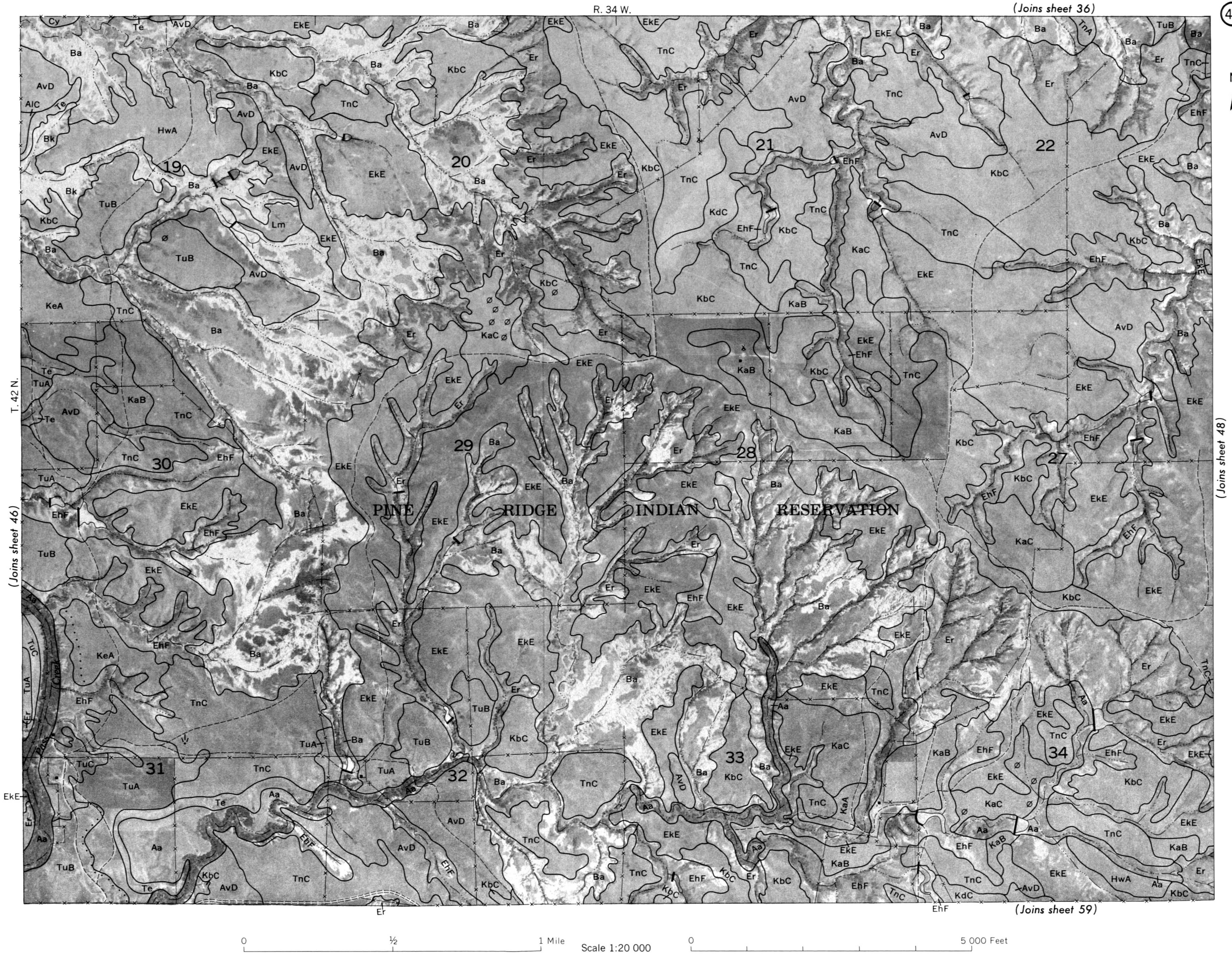
(Joins sheet 58)

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 46

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.



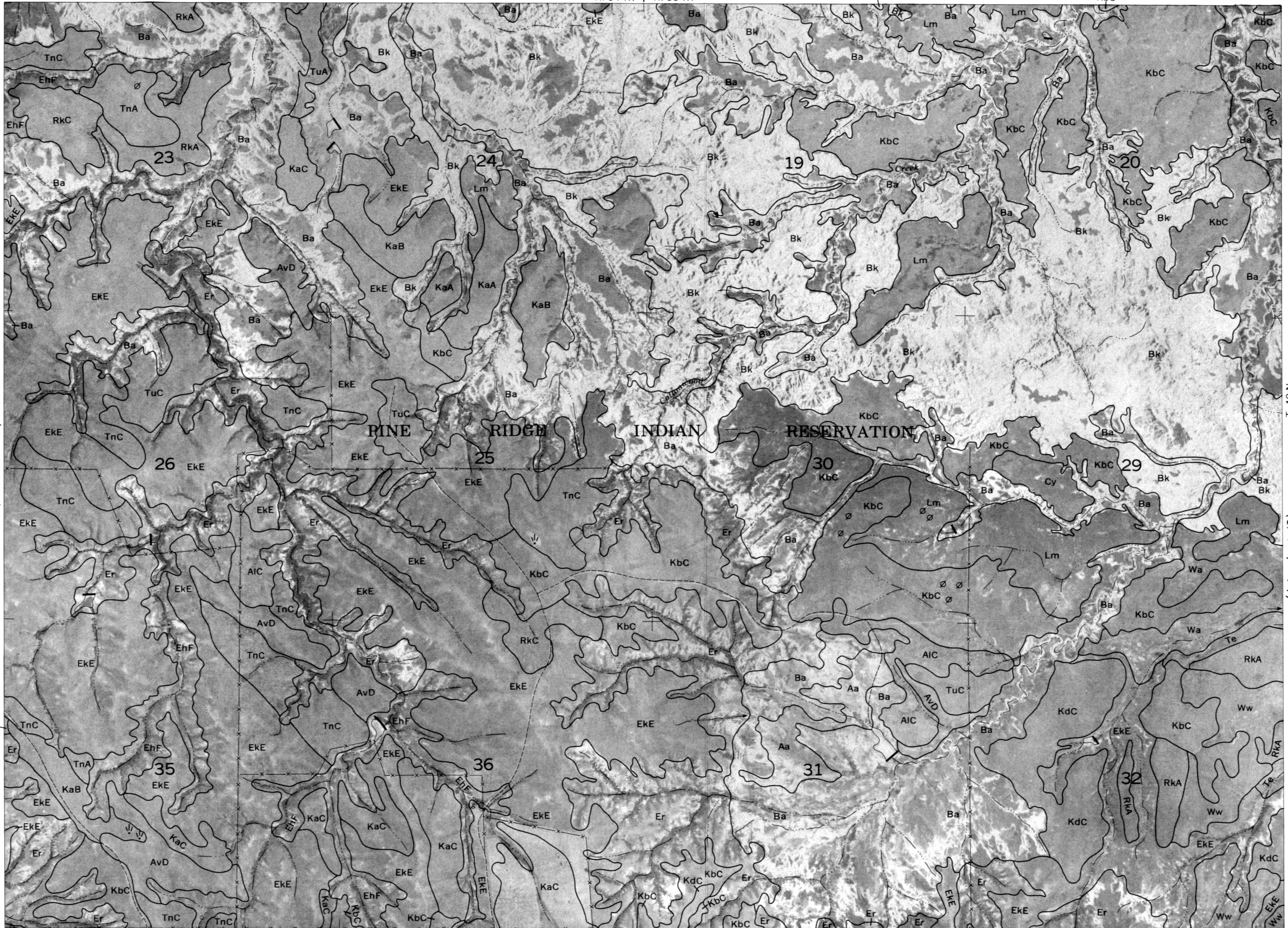
This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 47

(48)

(Joins sheet 37)

R. 34 W. | R. 33 W.



(Joins sheet 47)

(Joins sheet 49)

(Joins sheet 60)

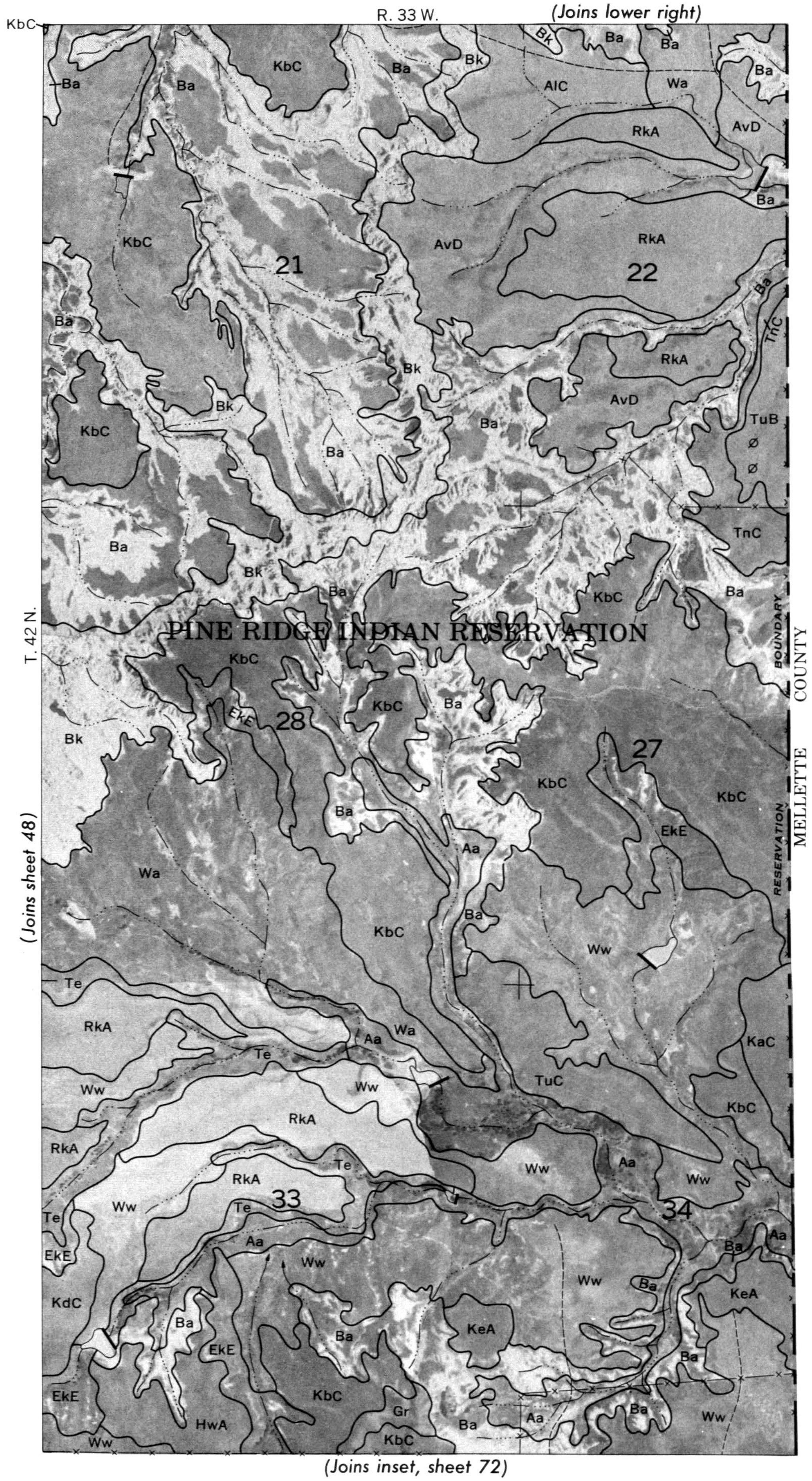
0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

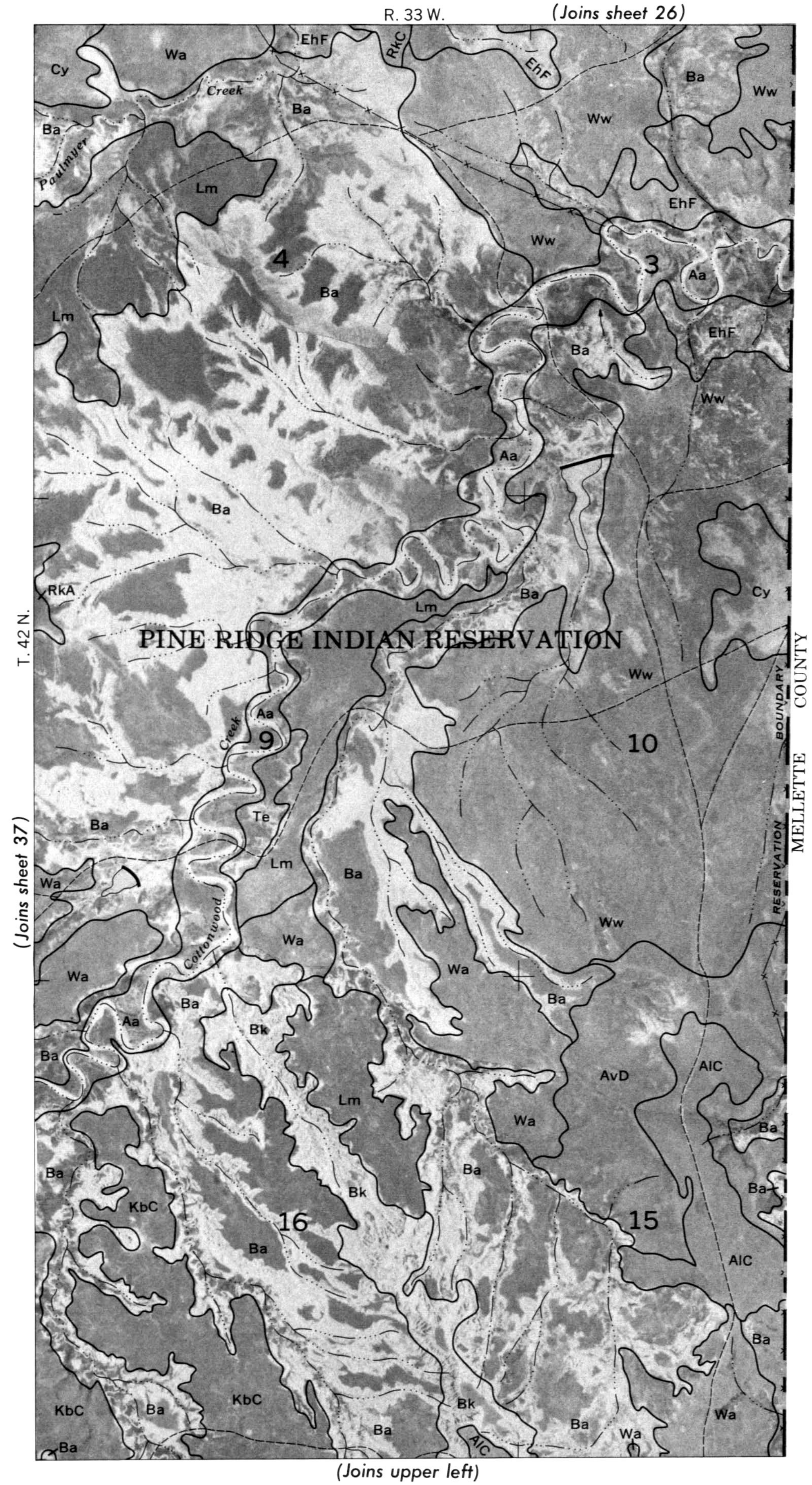
WASHABAUGH COUNTY, SOUTH DAKOTA NO. 48

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.

49





N

0 ½ 1 Mile

Scale 1:20 000

0 5 000 Feet

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 49

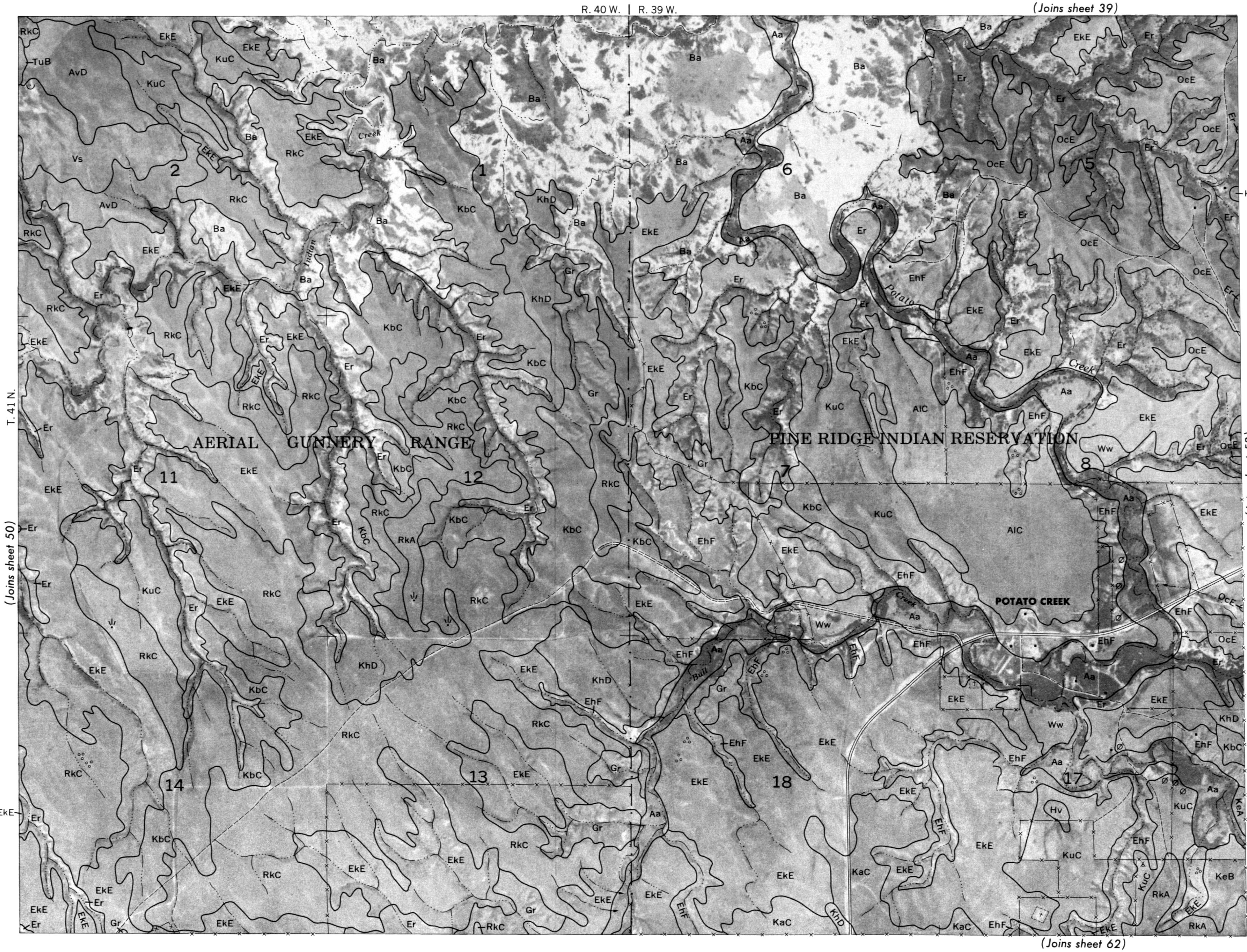
0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 50

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.

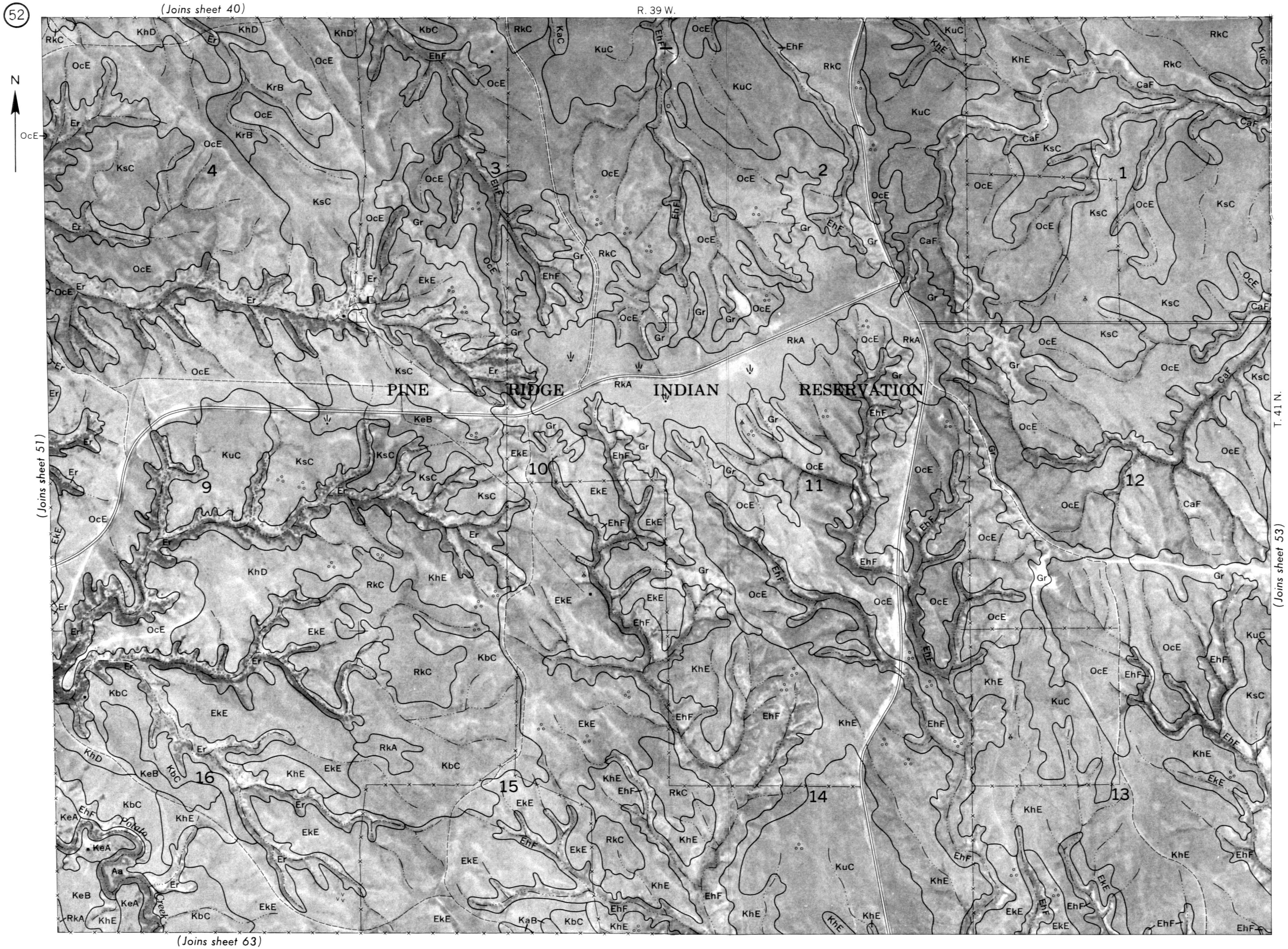
51



0 ½ 1 Mile
Scale 1:20 000
0 5 000 Feet

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 51

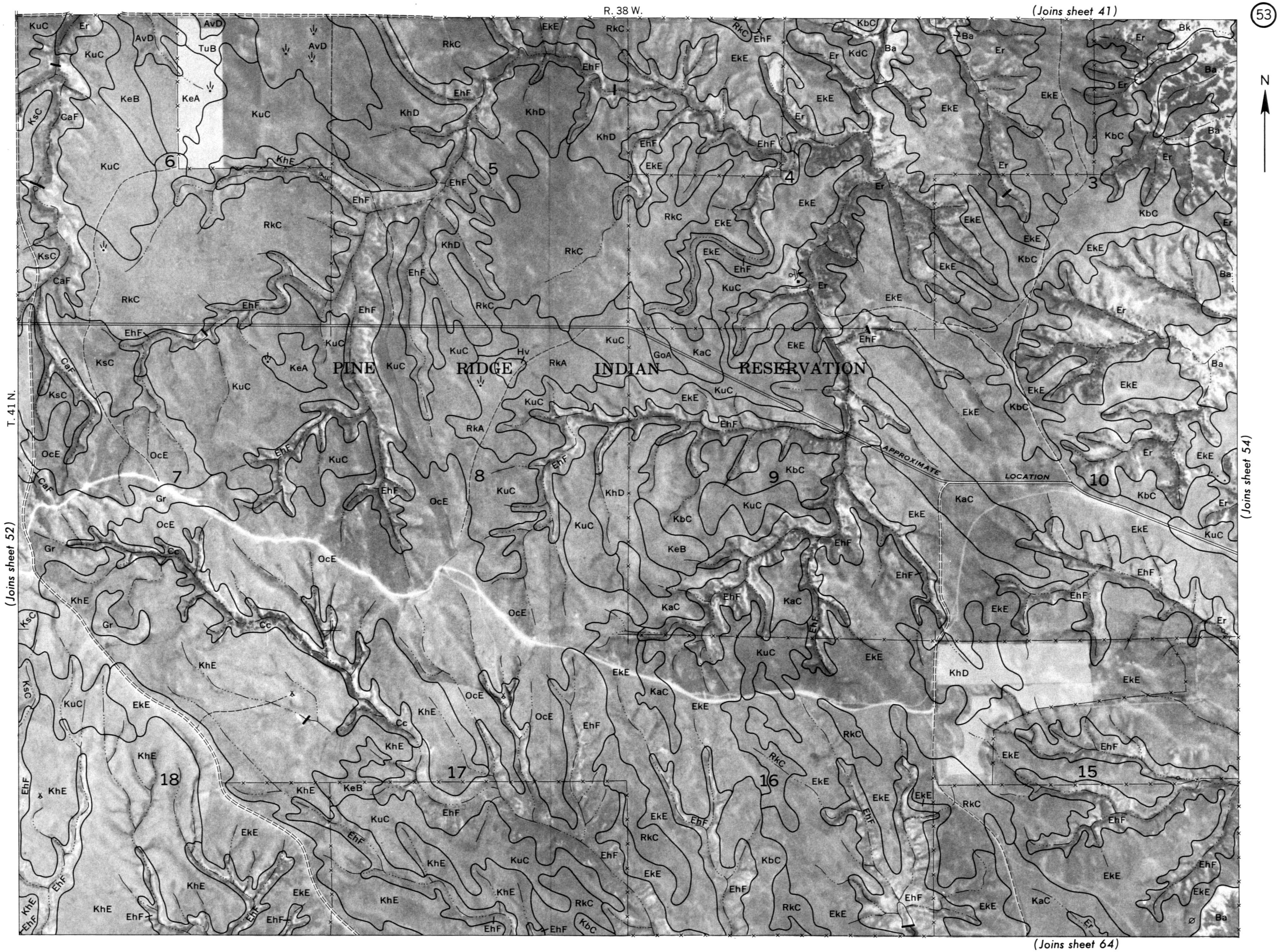


0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 52

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 53

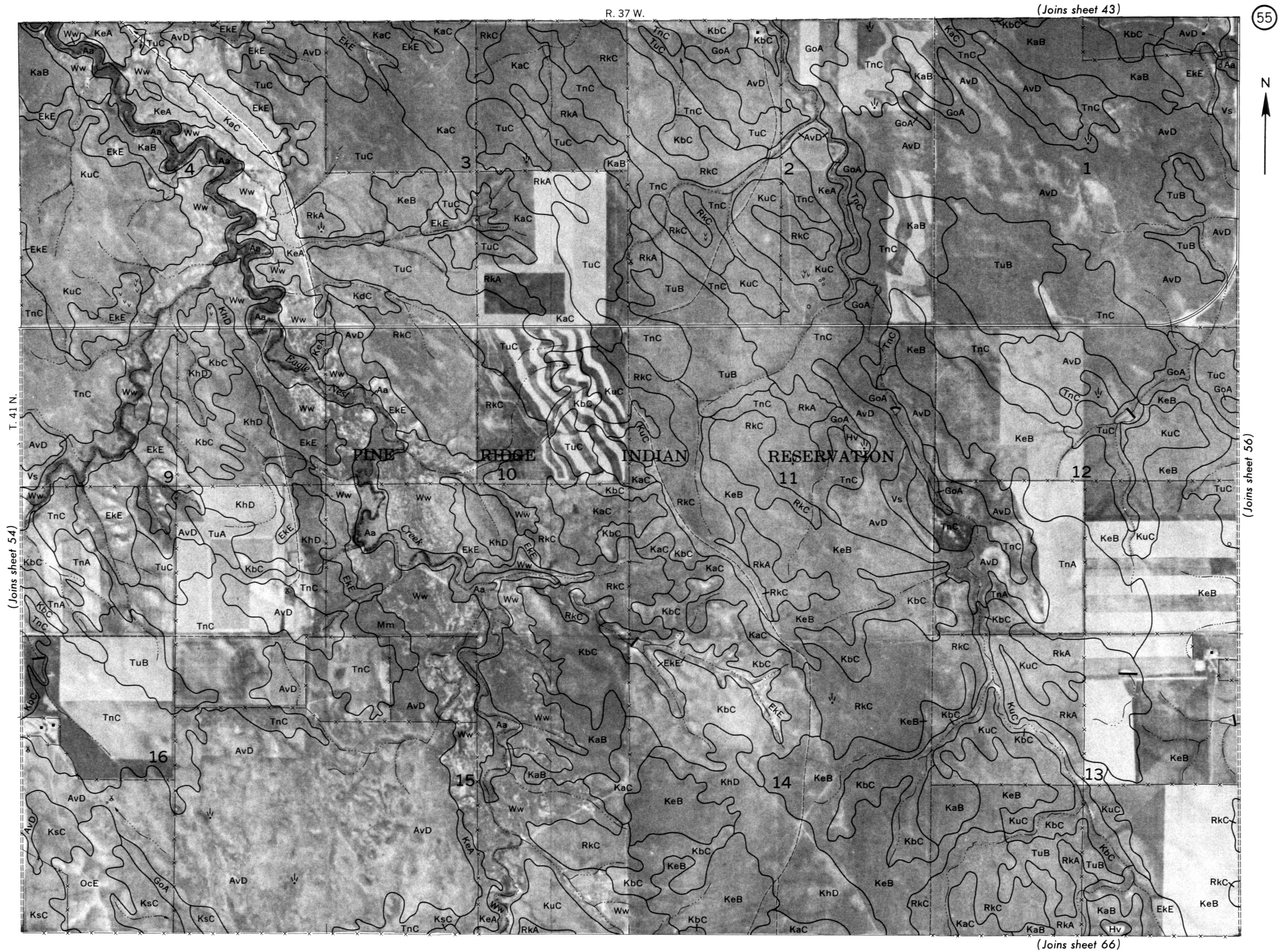
54

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 54

Land division corners are approximately positioned on this map.

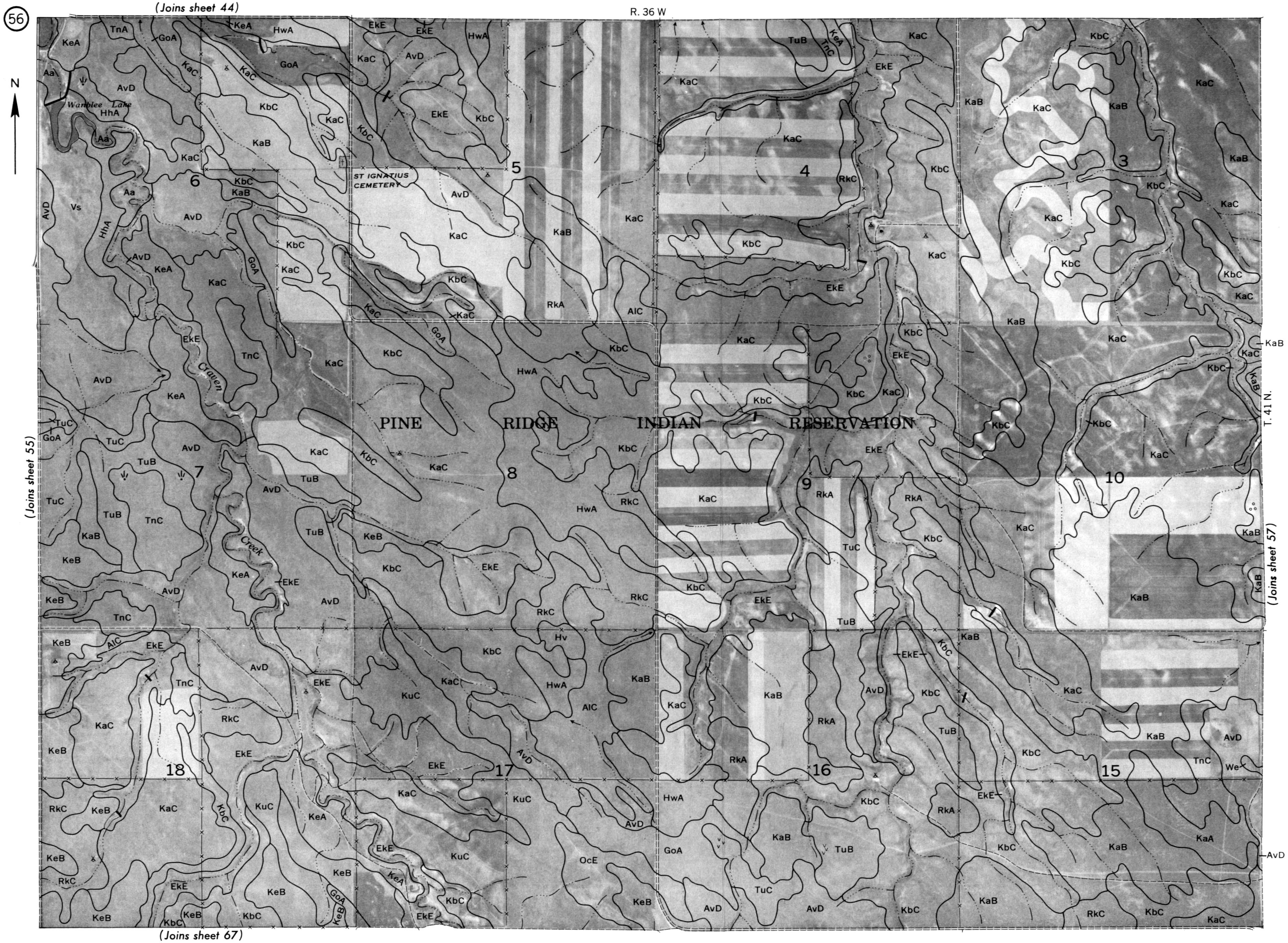
This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 55

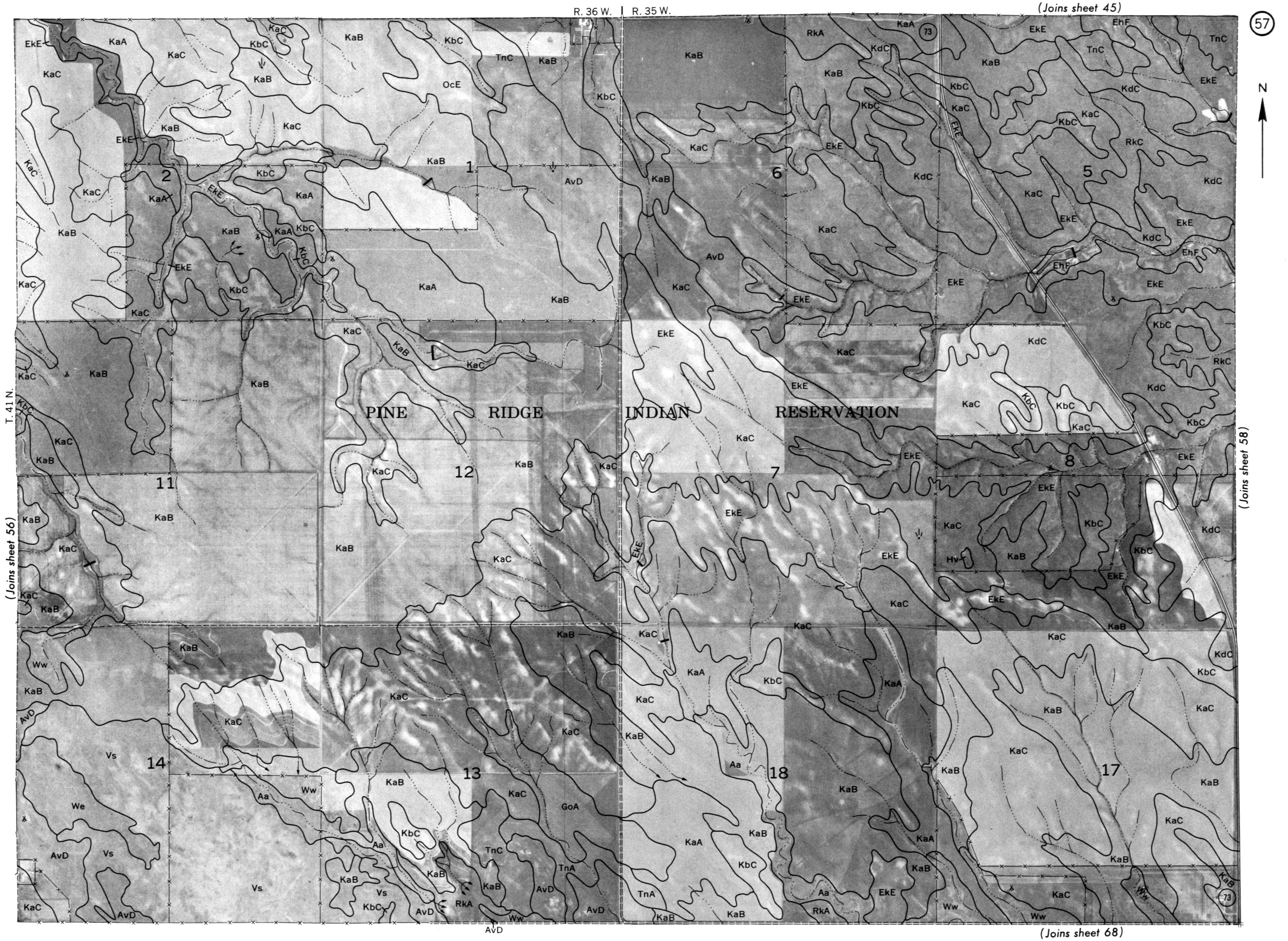


0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 56

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.

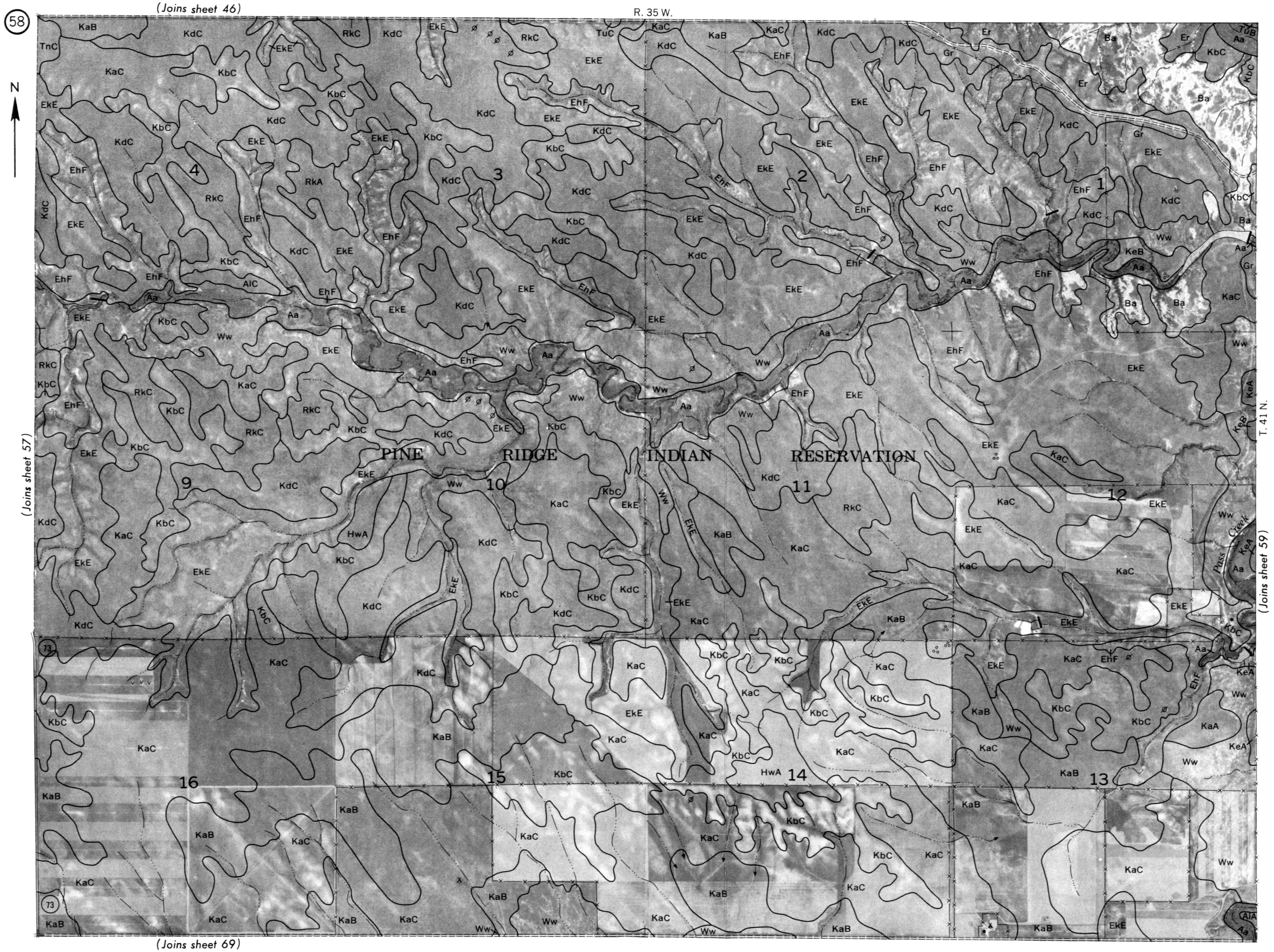


0 ½ 1 Mile

Scale 1:20 000

0 5 000 Feet

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

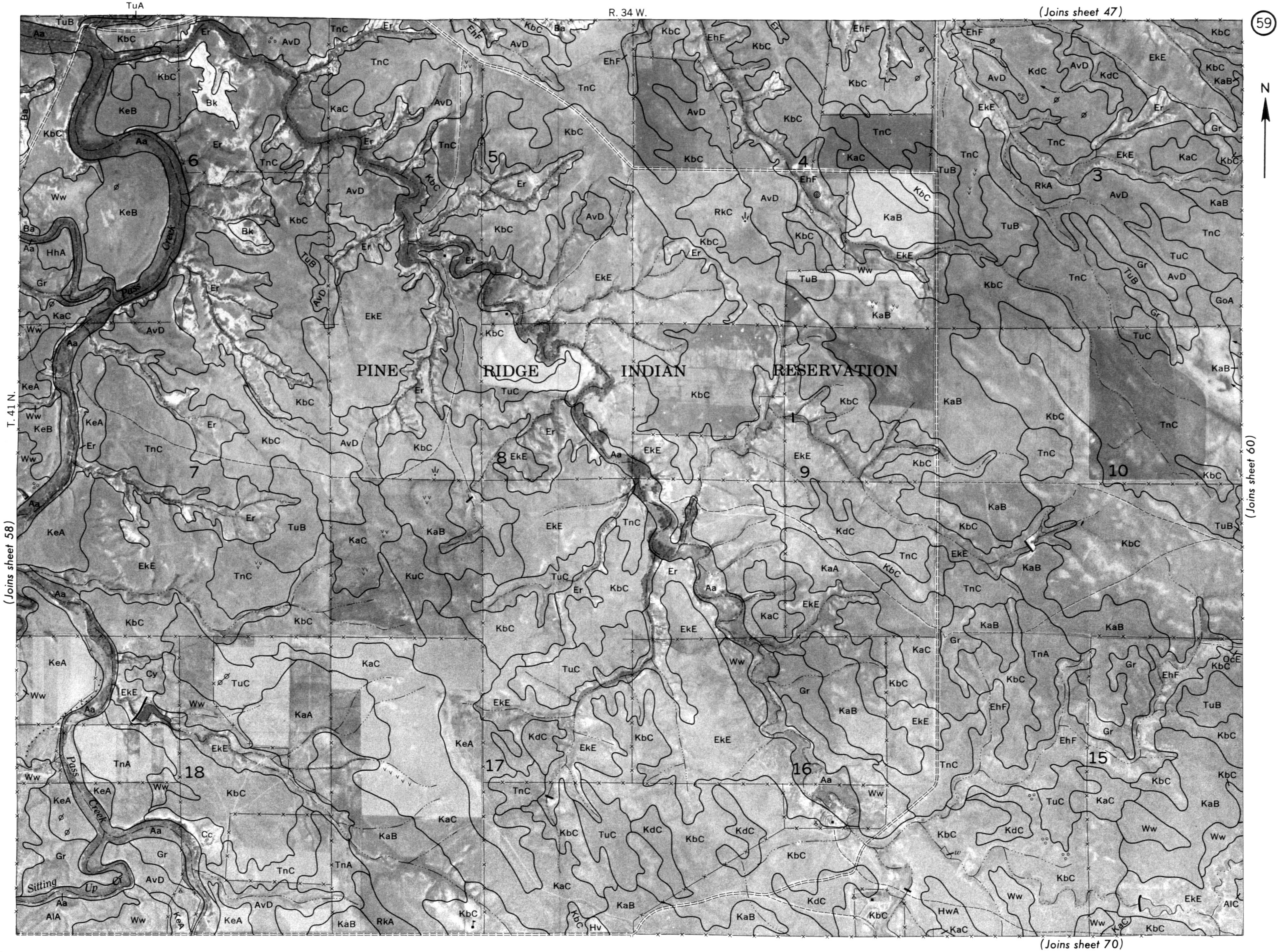


0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 58

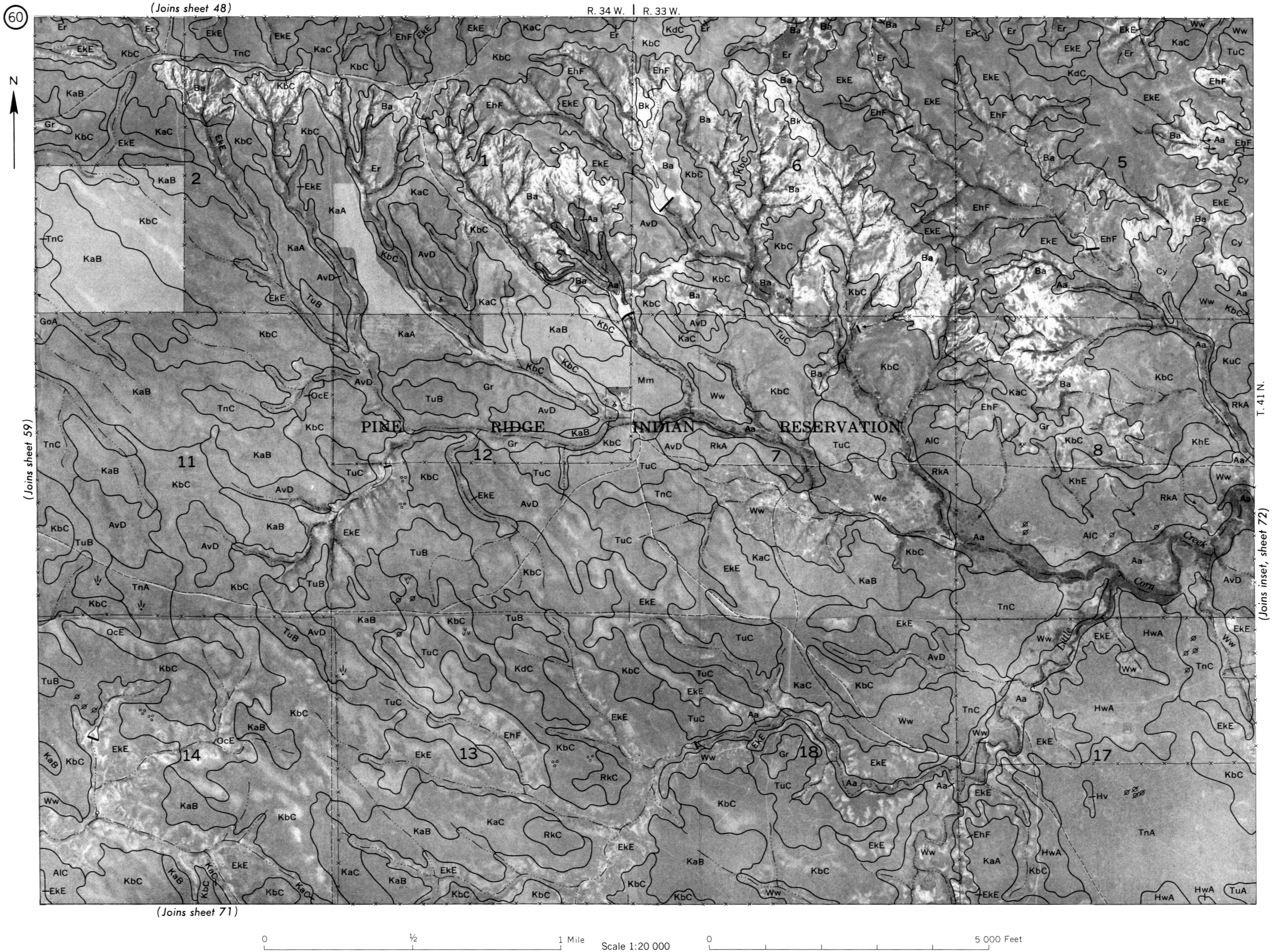
Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.



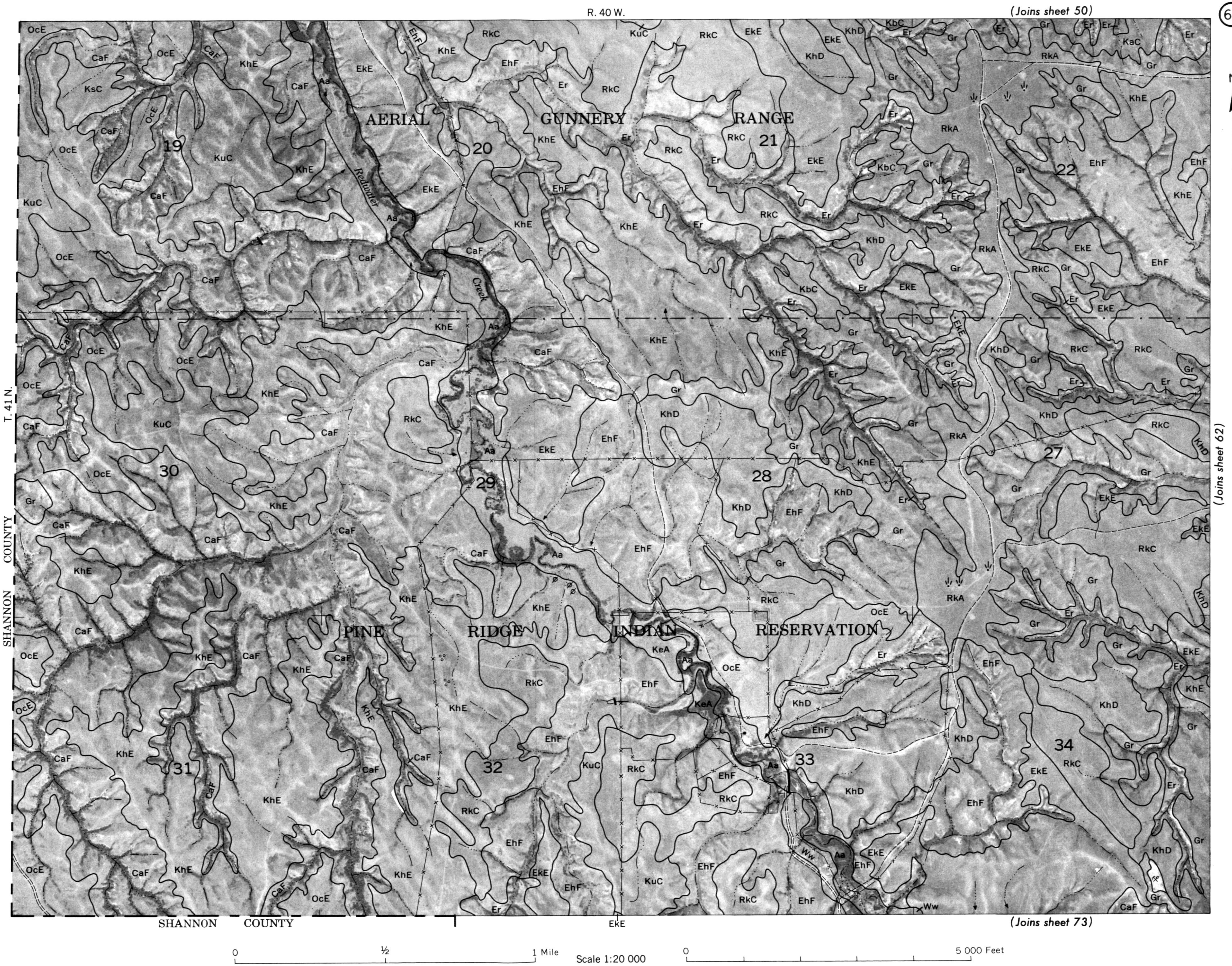
0 ½ 1 Mile
Scale 1:20 000
0 5 000 Feet

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.
Land division corners are approximately positioned on this map.



Land division corners are approximately positioned on this map.

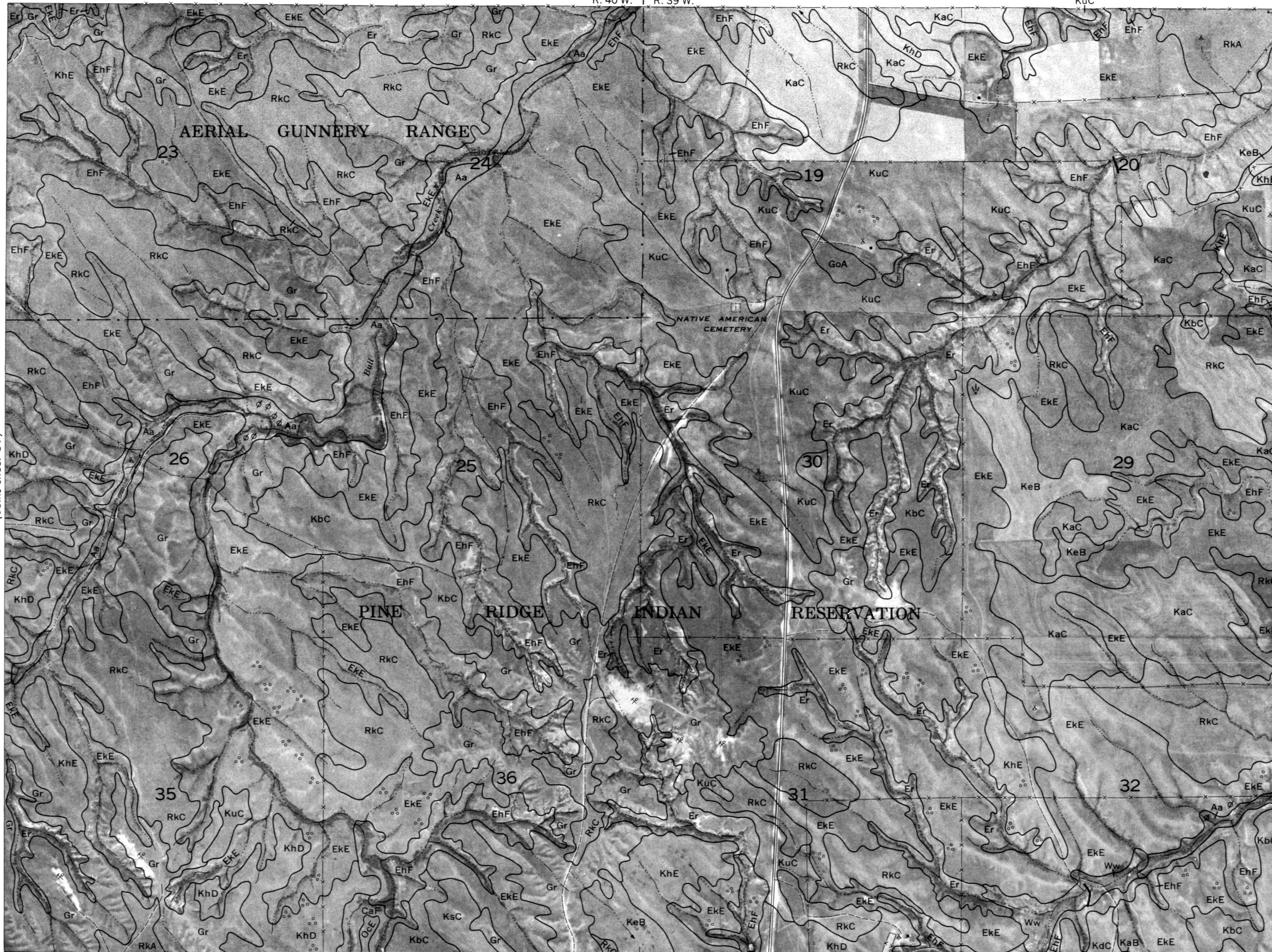
This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.



is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 61

62



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

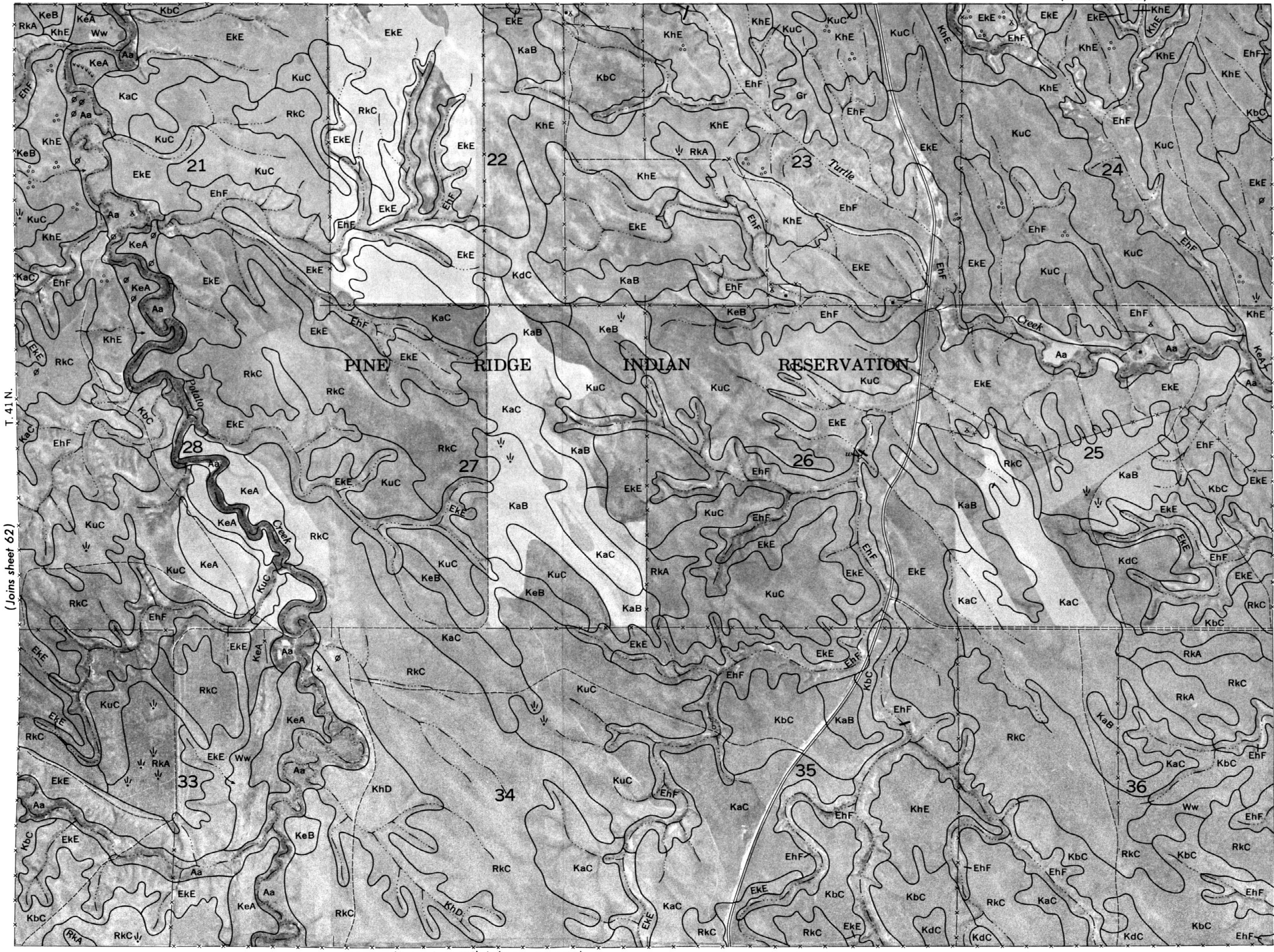
WASHABAUGH COUNTY, SOUTH DAKOTA NO. 62

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.

(63)

R. 39 W. (Joins sheet 52)



(Joins sheet 74) | (Joins sheet 75)

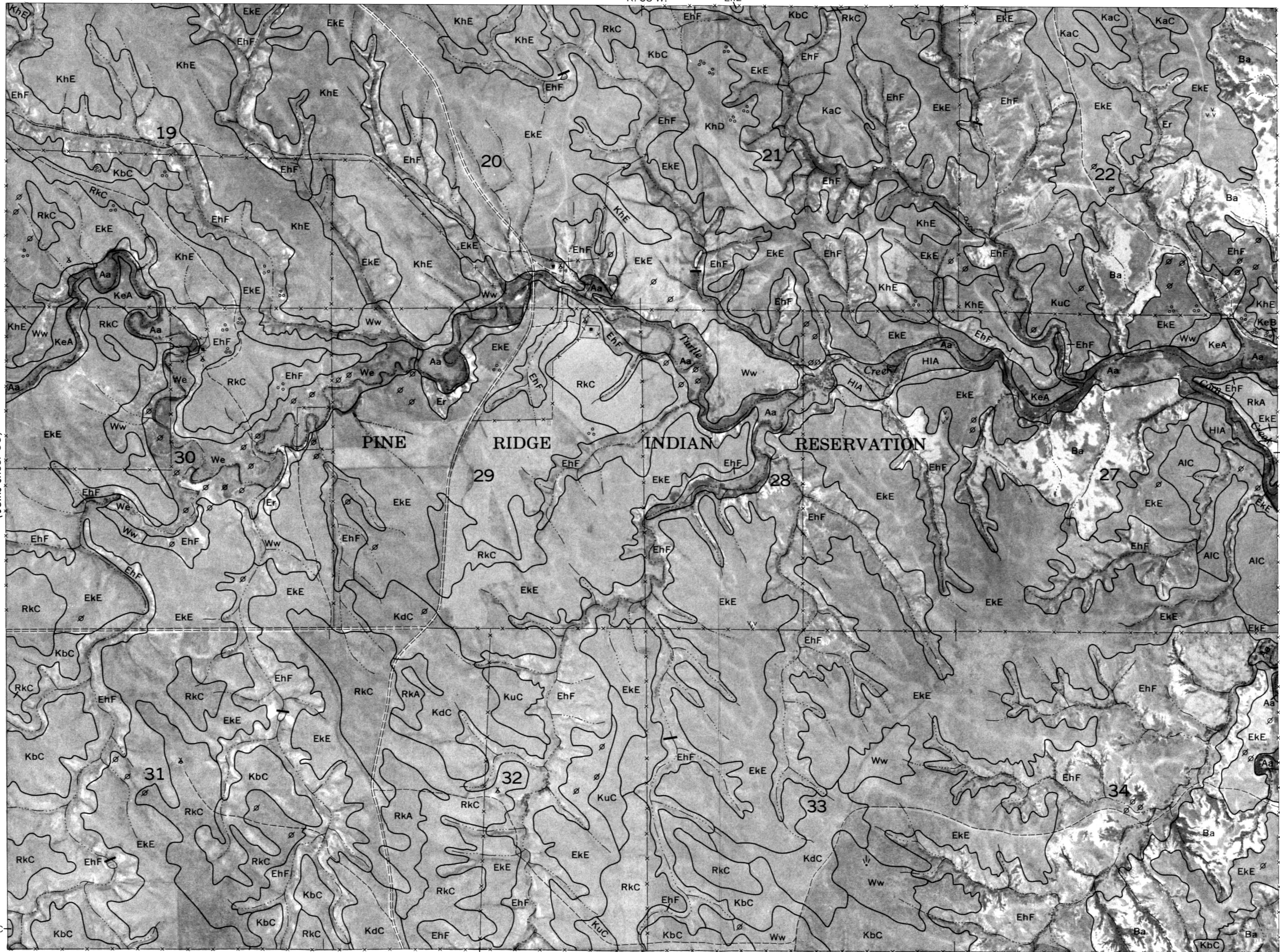
0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 63

64

(Joins sheet 53)



(Joins sheet 63)

(Joins sheet 65)

(Joins sheet 75) | (Joins sheet 76)

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 64

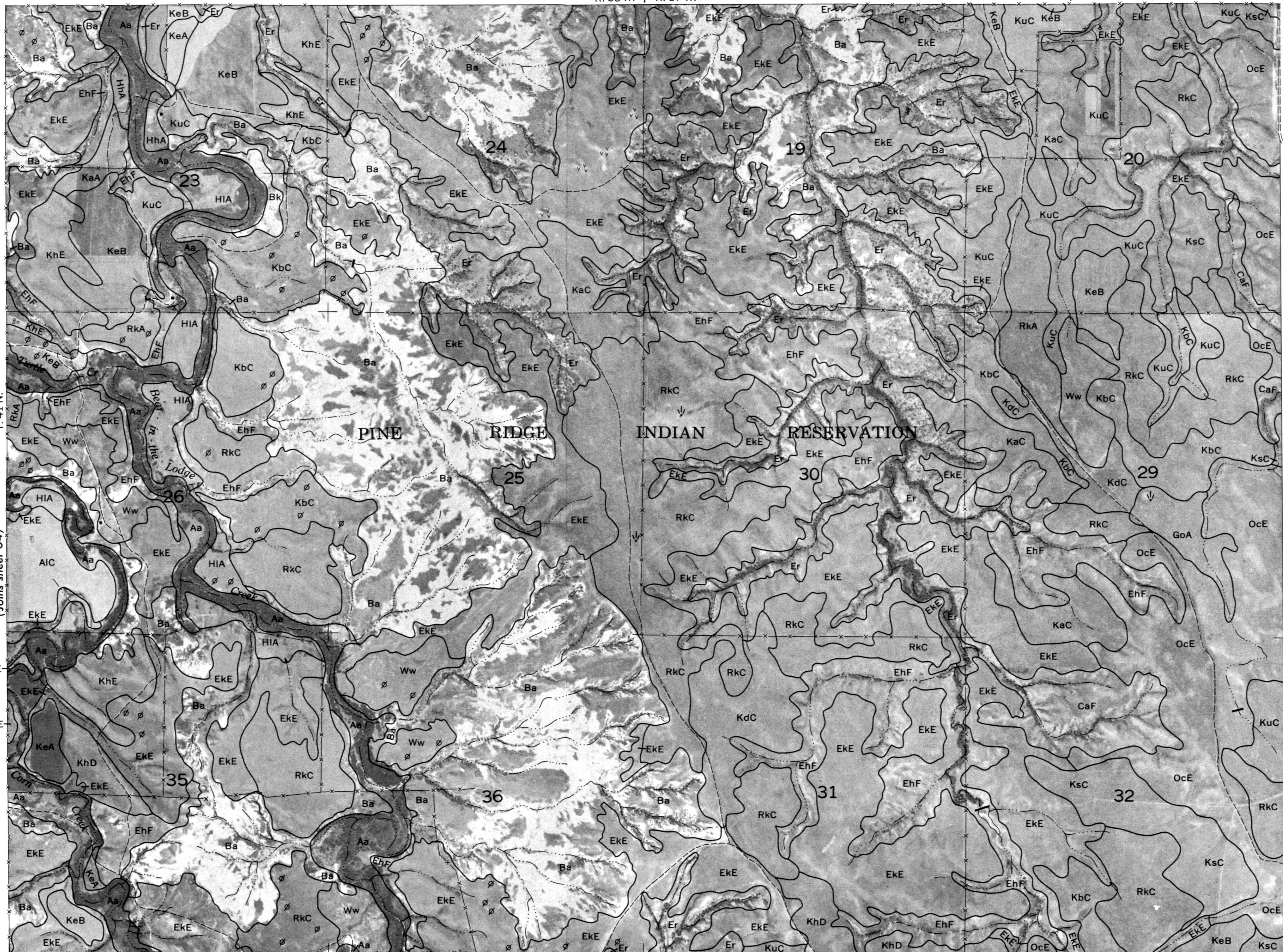
Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.

65

R. 38 W. | R. 37 W.

(Joins sheet 54)



T. 41 N.

(Joins sheet 64)

(Joins sheet 66)

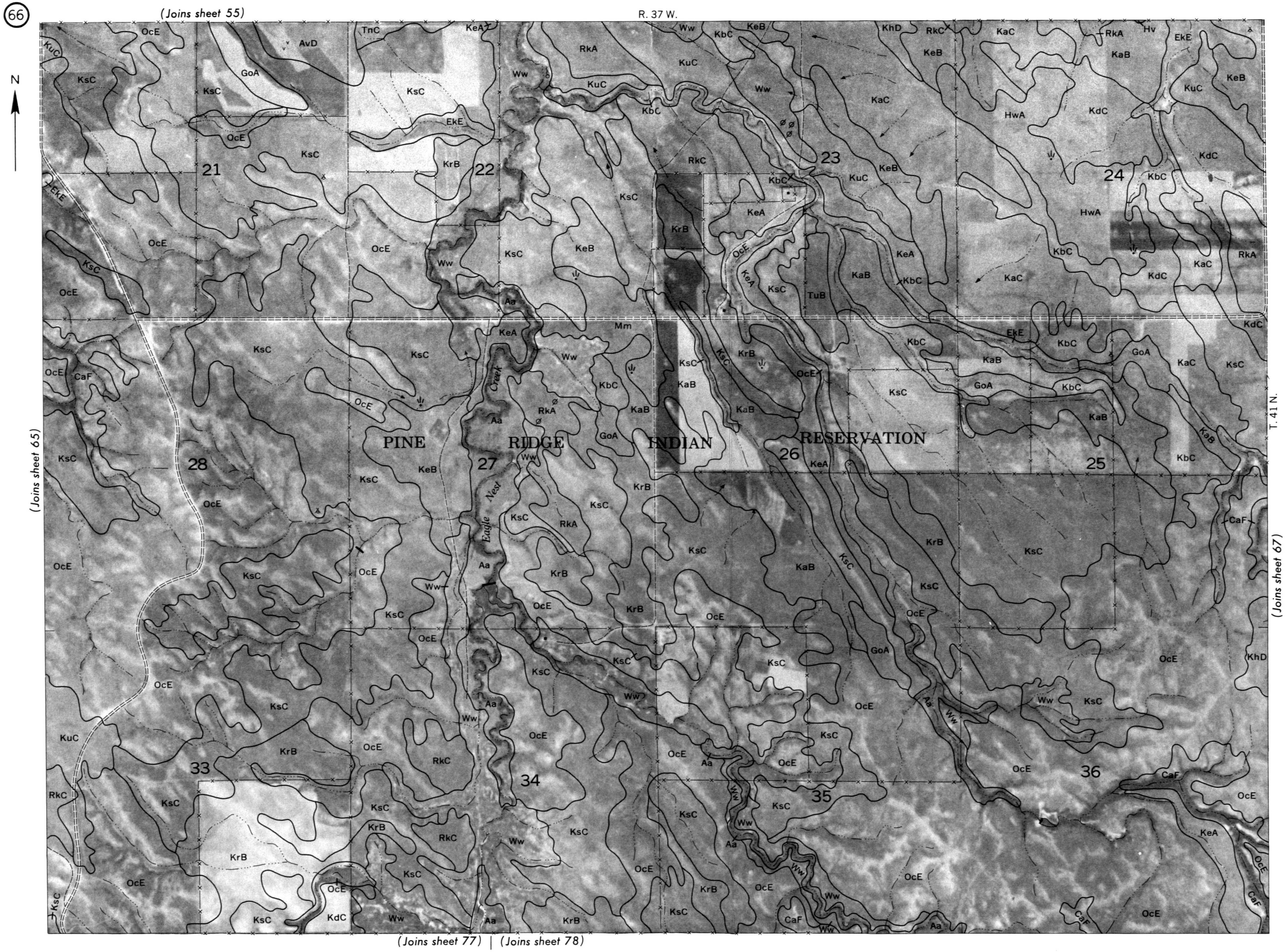
(Joins sheet 76) | (Joins sheet 77)

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 65

(66)



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 66

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.

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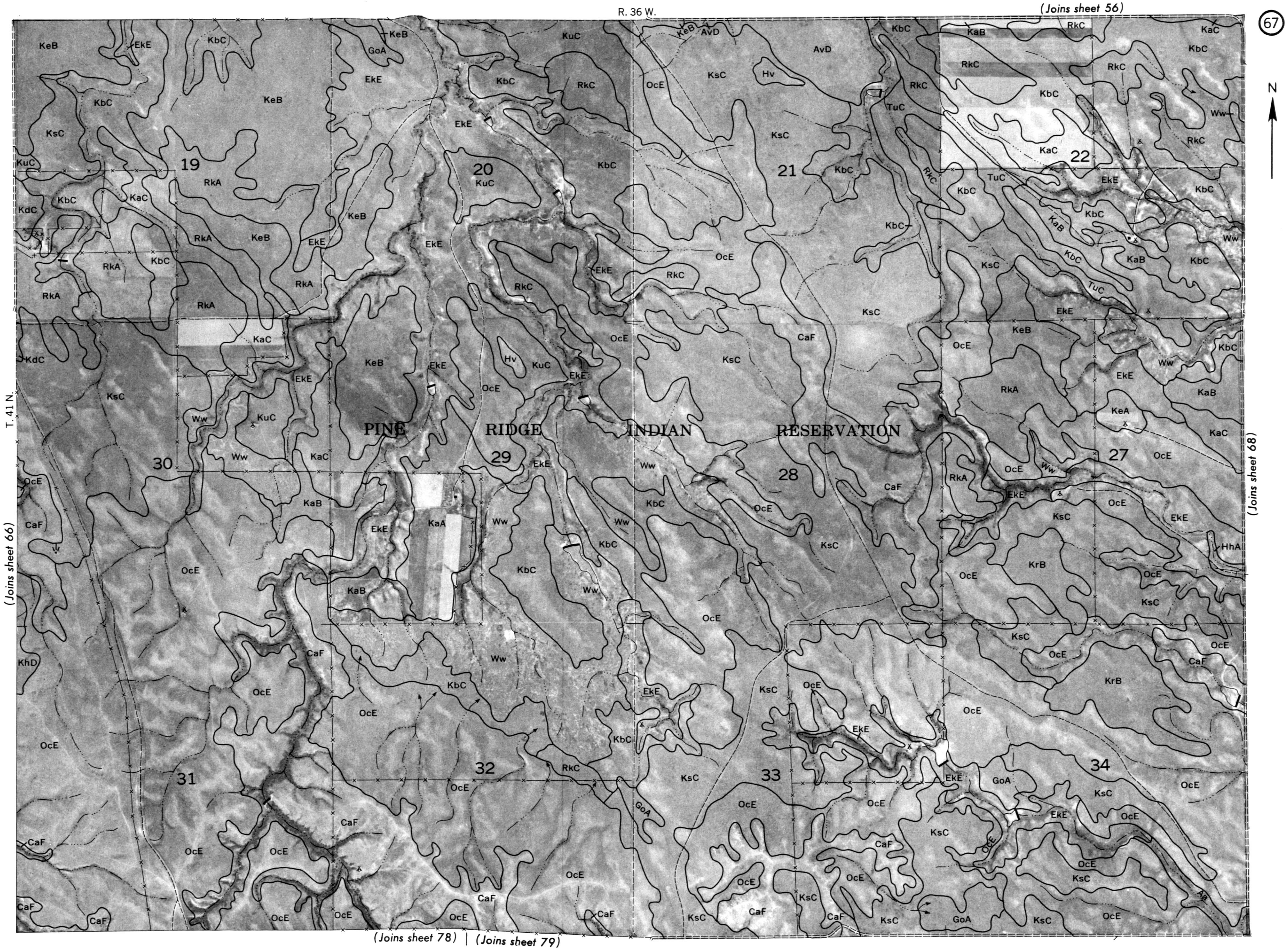
Land division corners are approximately positioned on this map.

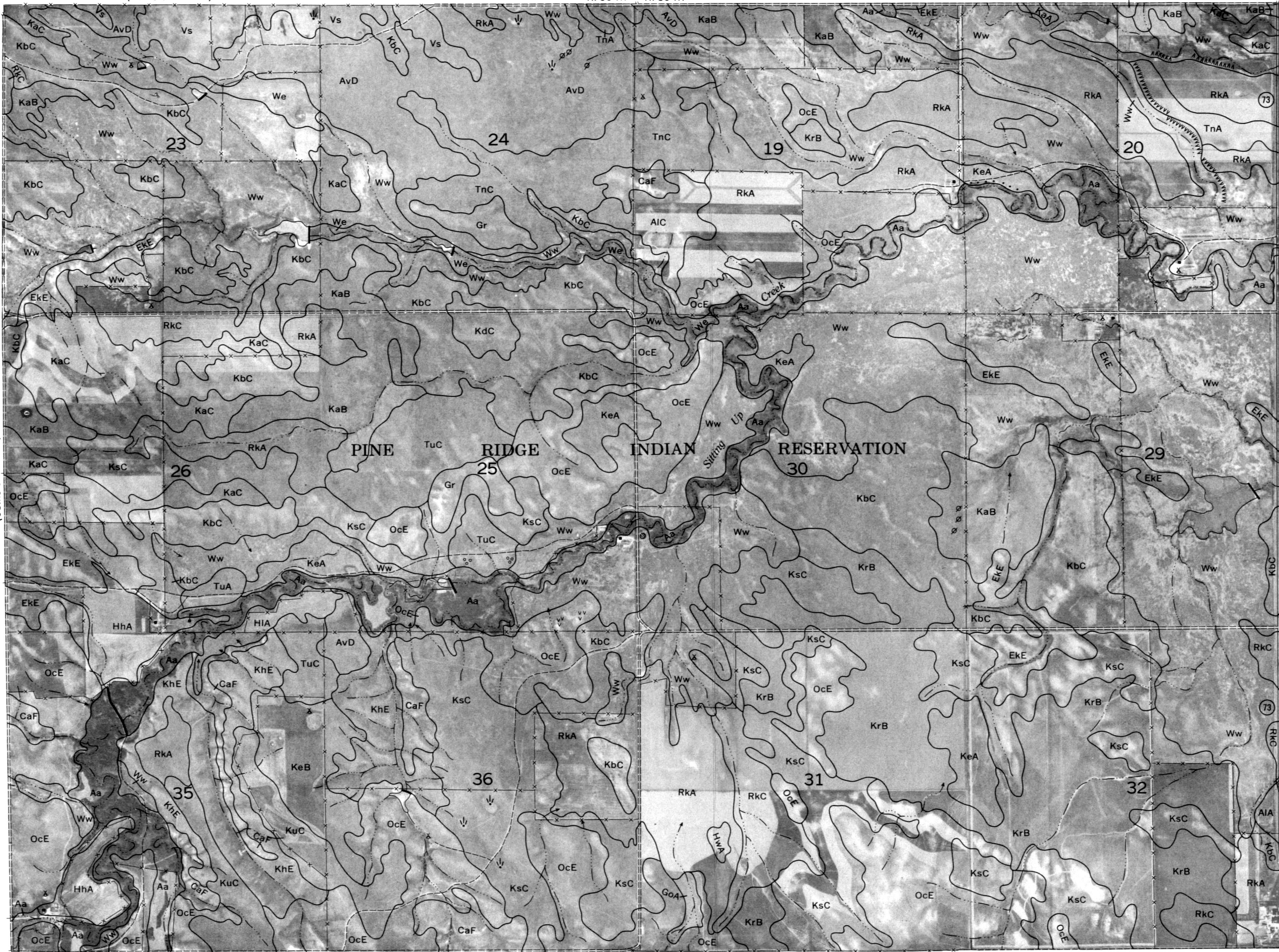
WASHABAUGH COUNTY, SOUTH DAKOTA NO. 67



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

(Joins sheet 57)

R. 36 W. | R. 35 W.



(Joins sheet 67)

(Joins sheet 69)

(Joins sheet 79) | (Joins sheet 80)

0 ½ 1 Mile

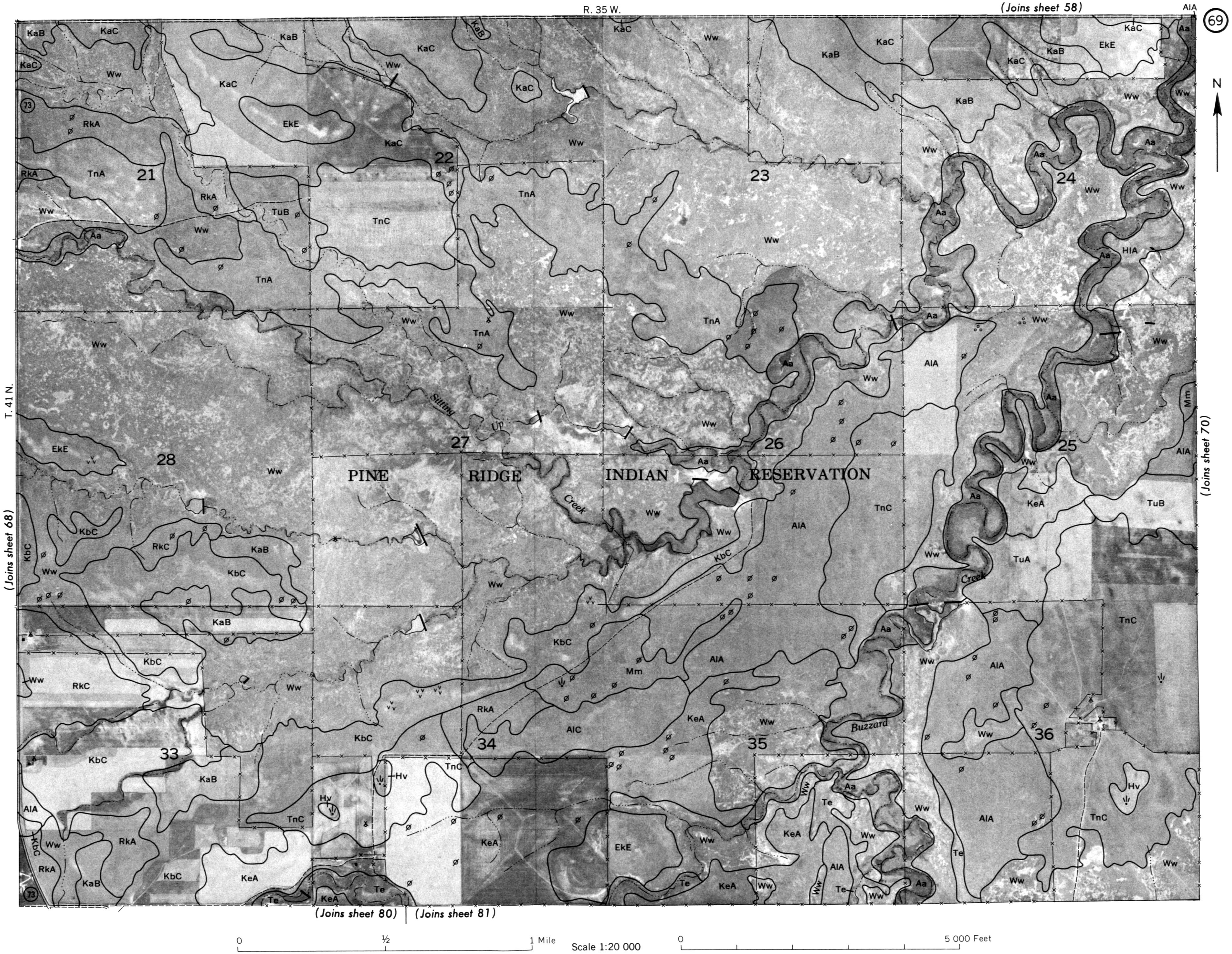
Scale 1:20 000

0 5 000 Feet

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 68

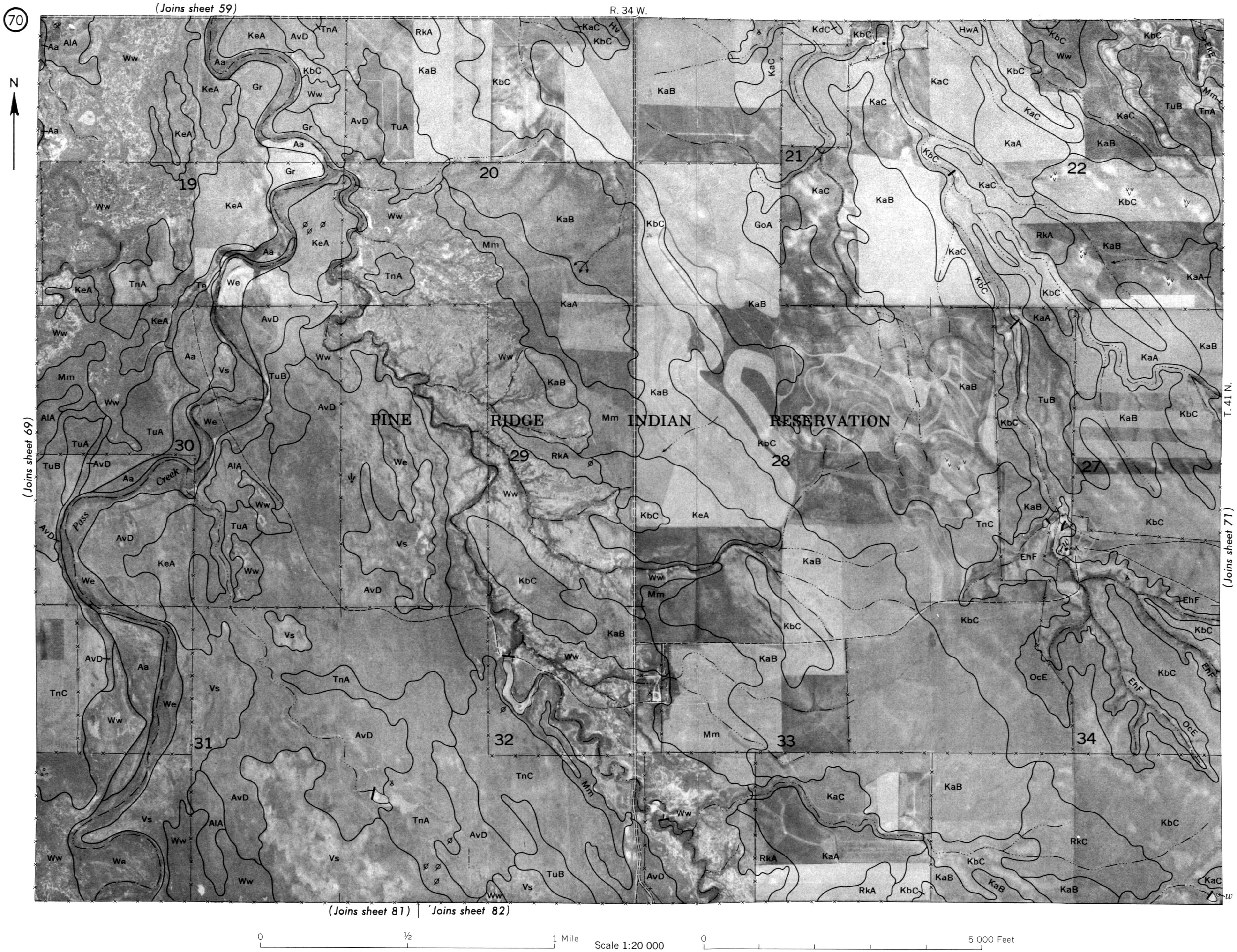
Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.



This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 69



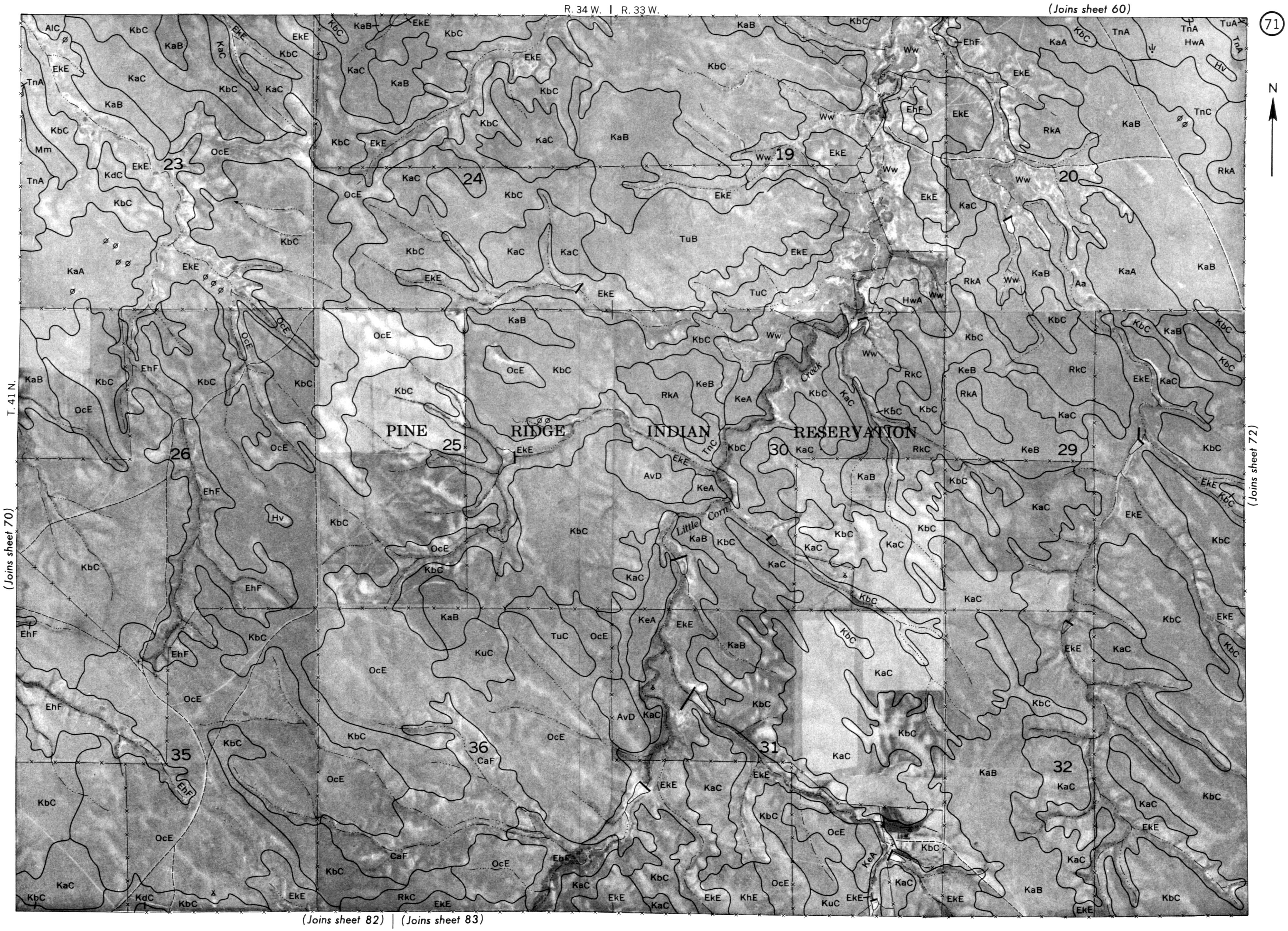
WASHABAUGH COUNTY, SOUTH DAKOTA NO. 70

Land division corners are approximately positioned on this map.

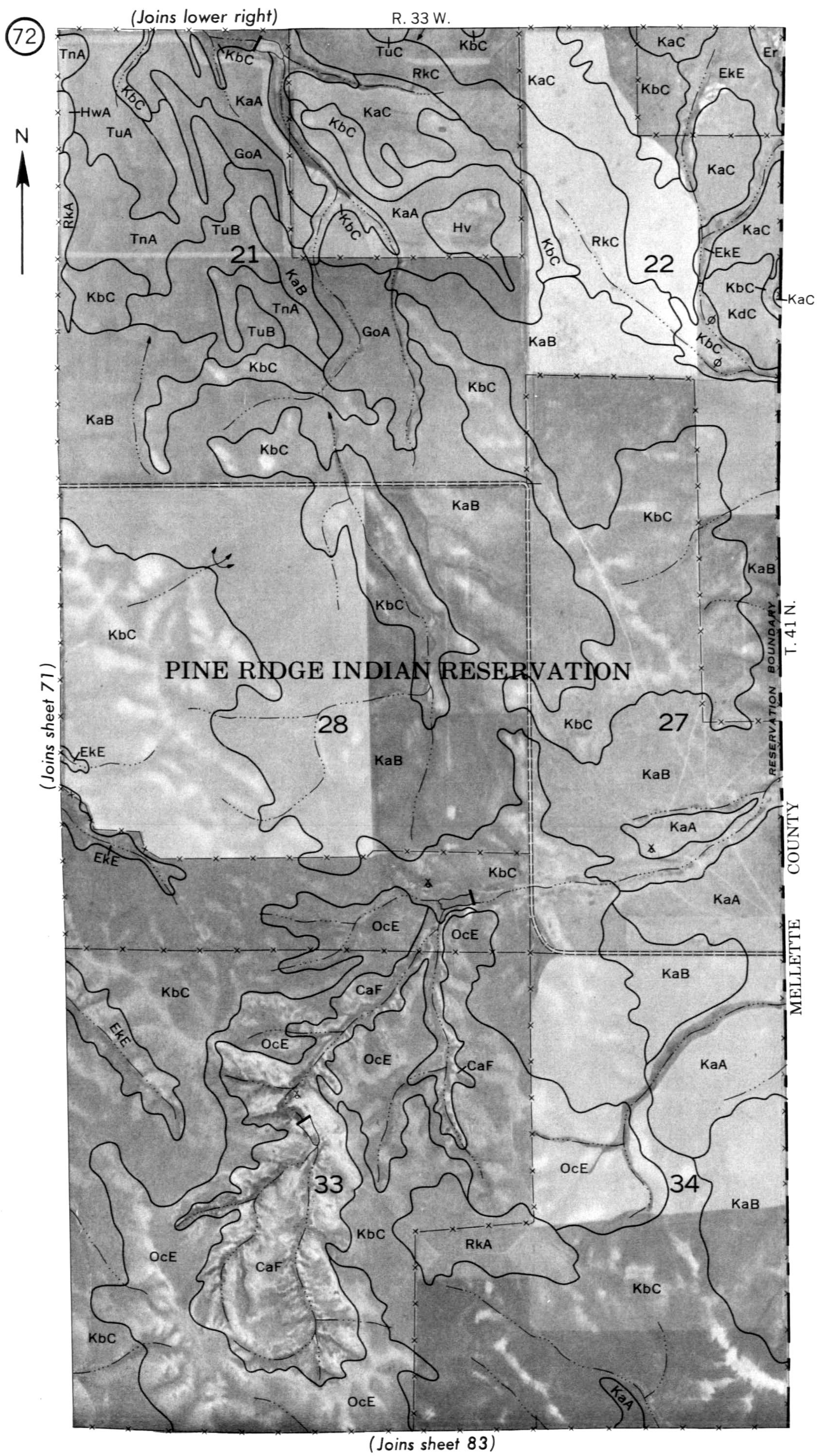
This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 71



0 ½ 1 Mile
Scale 1:20 000
0 5 000 Feet



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

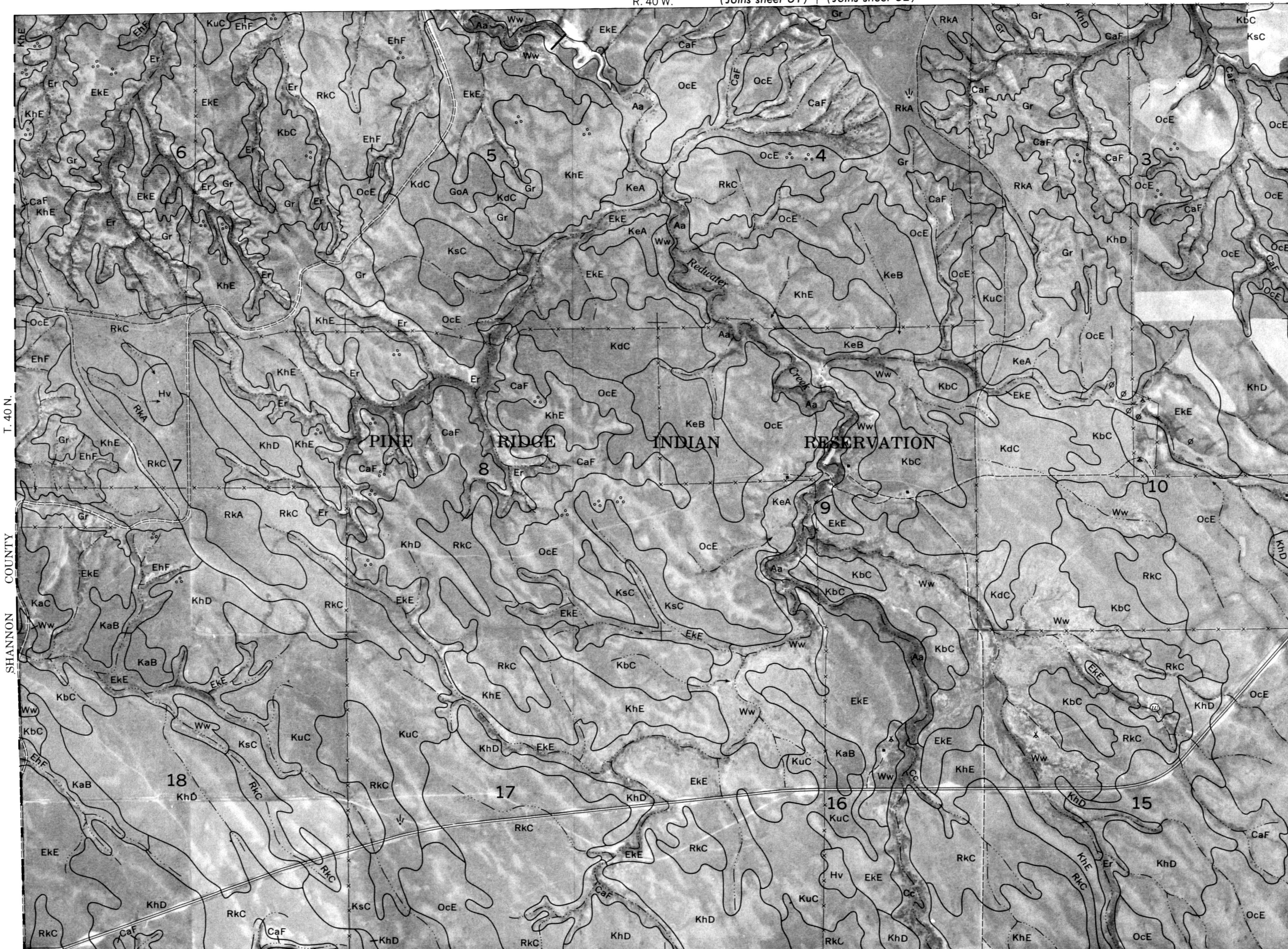
WASHABAUGH COUNTY, SOUTH DAKOTA NO. 72

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.

73

R. 40 W. (Joins sheet 61) | (Joins sheet 62)



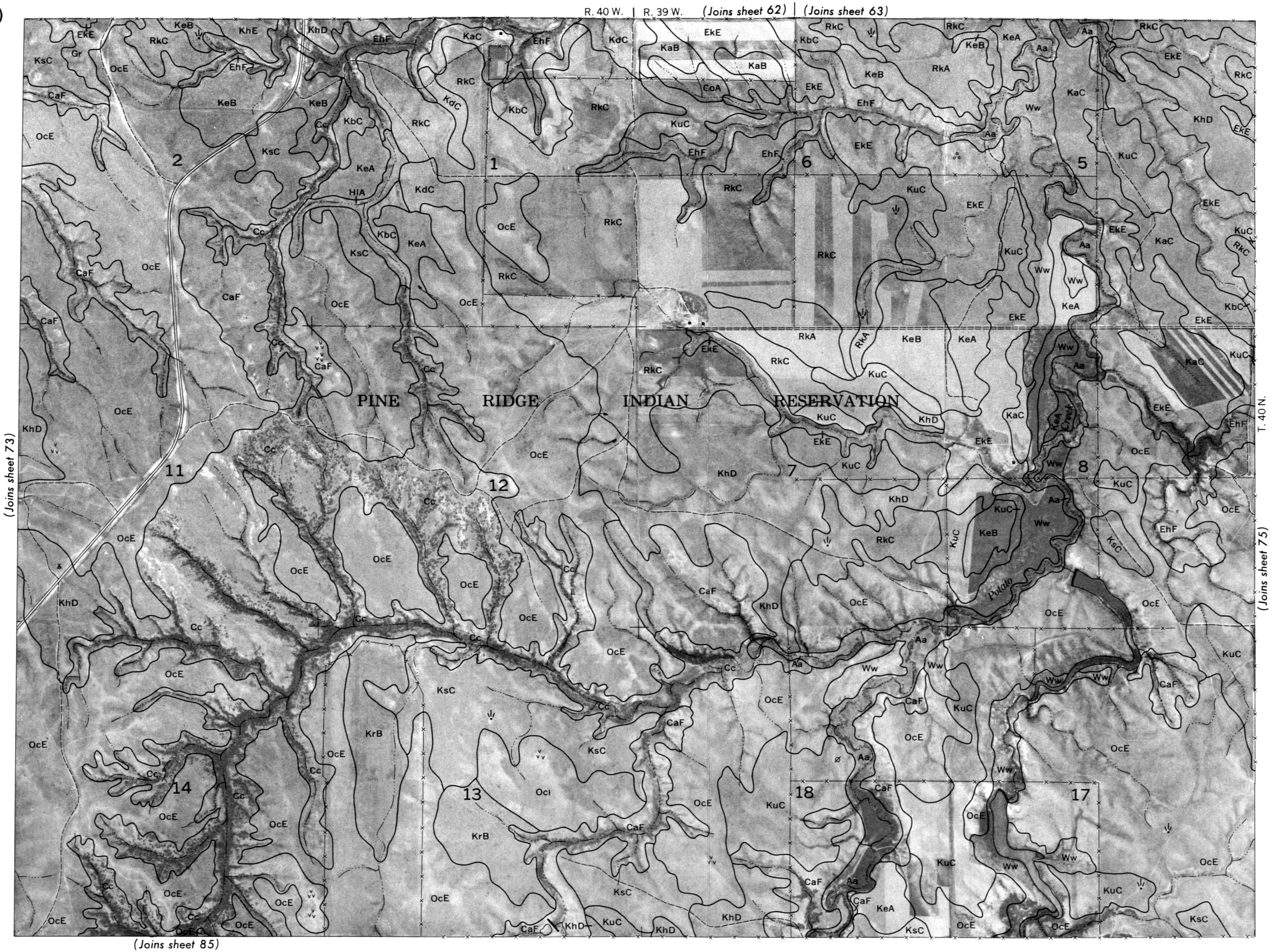
(Joins sheet 74)

(Joins sheet 84)

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.

Land division corners are approximately positioned on this map.



0 ½ 1 Mile
Scale 1:20 000
0 5 000 Feet

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 74

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.

75

R. 39 W. (Joins sheet 63) | (Joins sheet 64)

T. 40 N.

(Joins sheet 74)

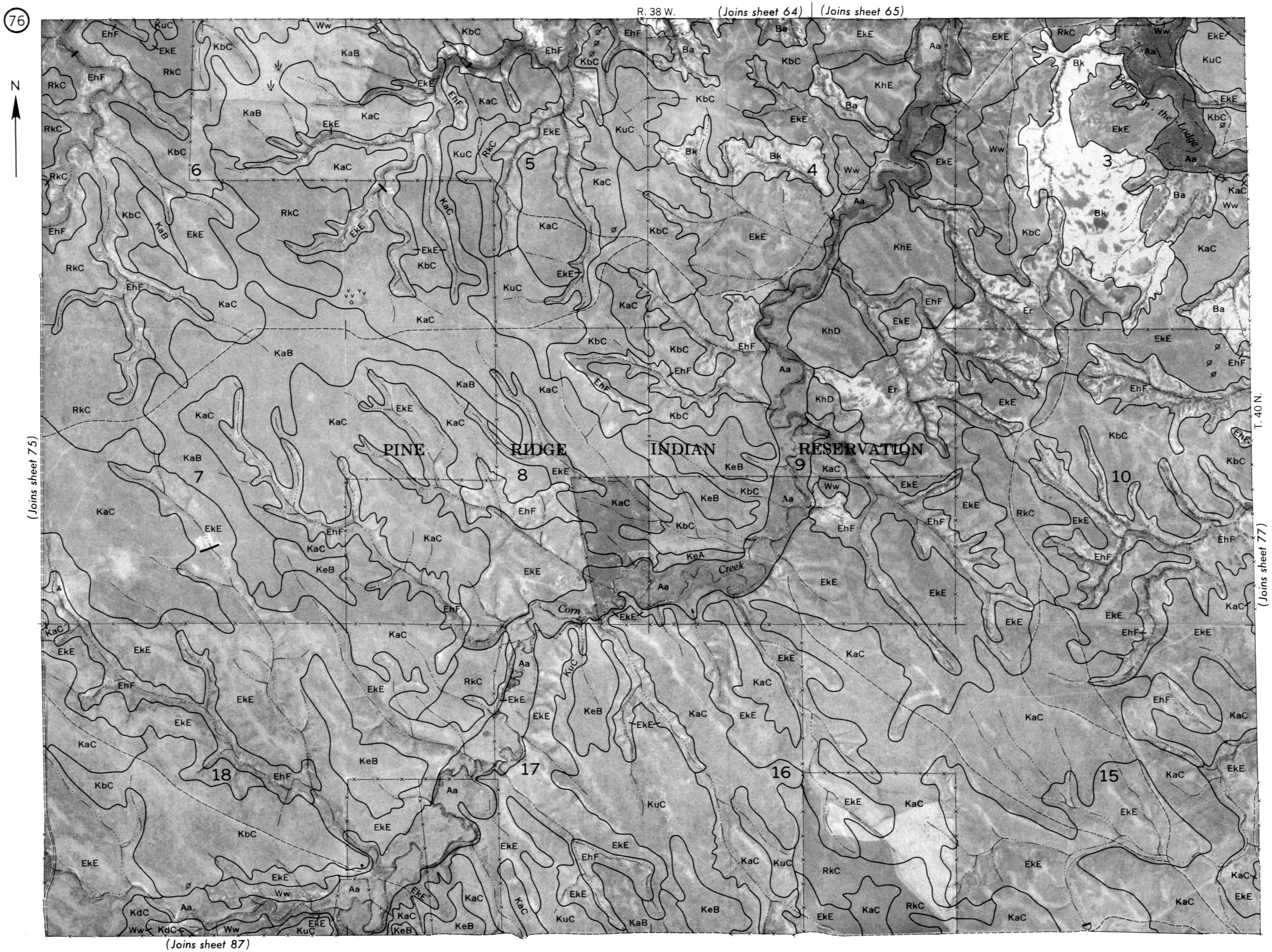
(Joins sheet 76)

(Joins sheet 86)

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 75

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.
Land division corners are approximately positioned on this map.



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 76

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.

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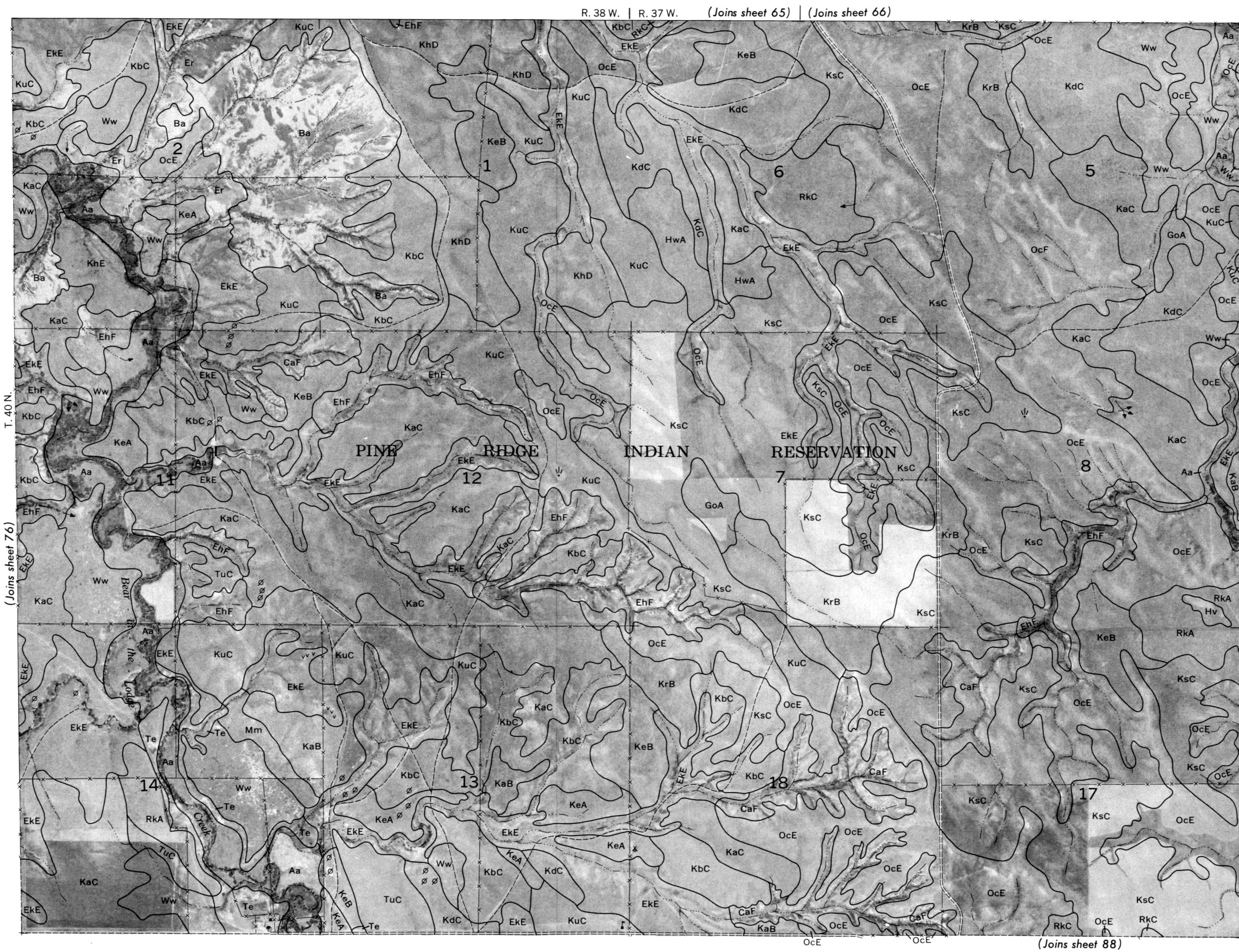
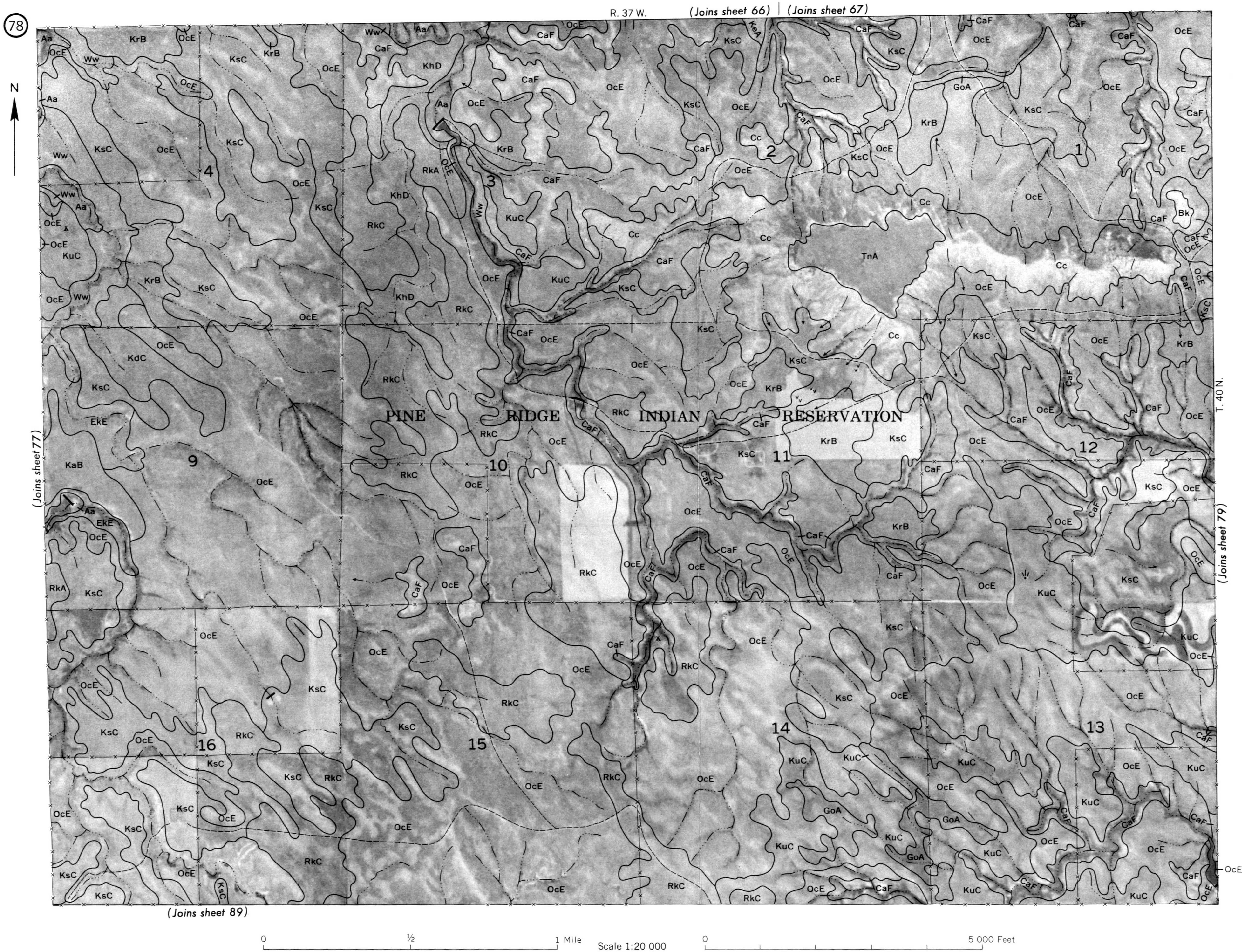
Land division corners are approximately positioned on this map.

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 77



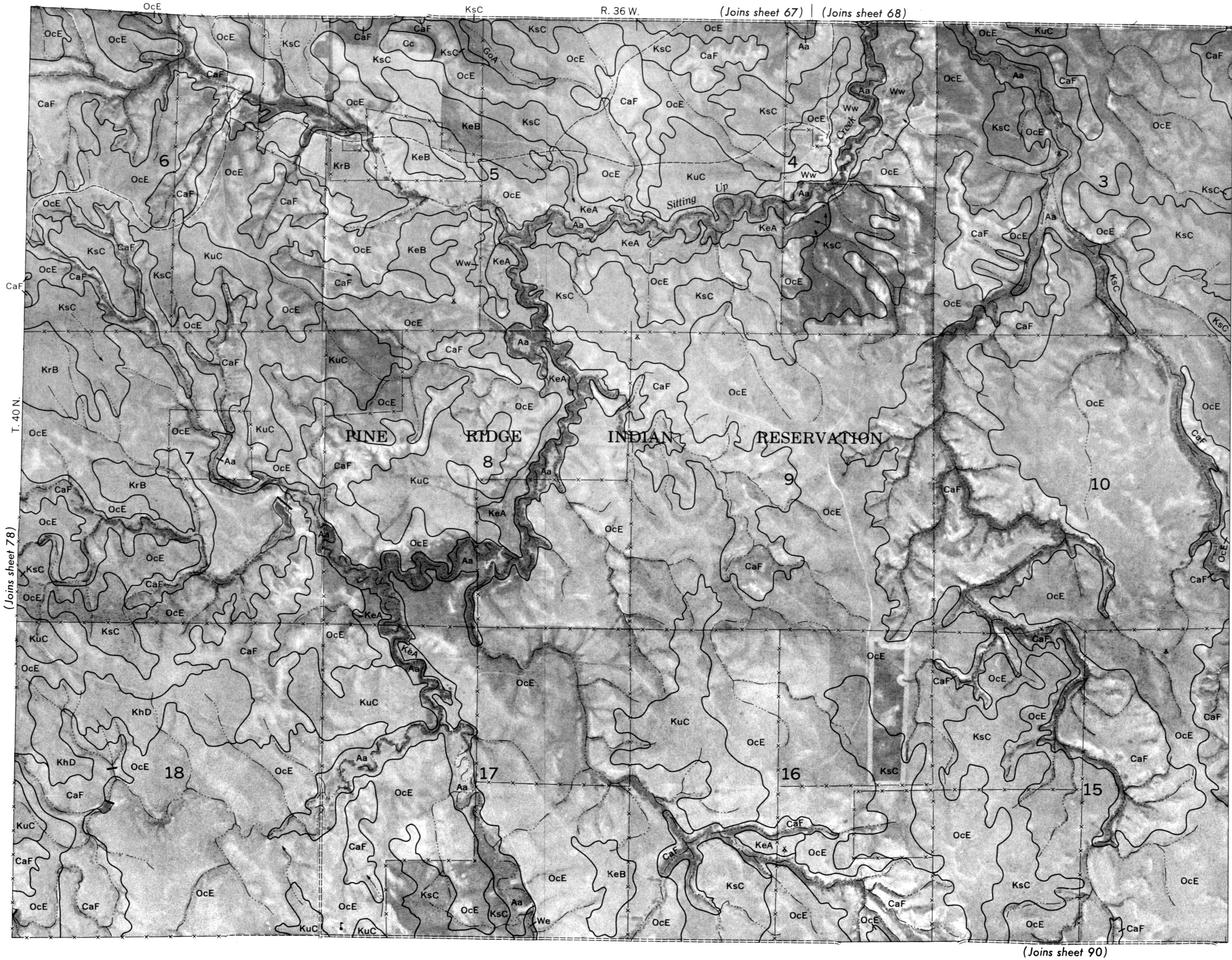
0 ½ 1 Mile
Scale 1:20 000
0 5 000 Feet



WASHABAUGH COUNTY, SOUTH DAKOTA NO. 78

Land division corners are approximately positioned on this map.

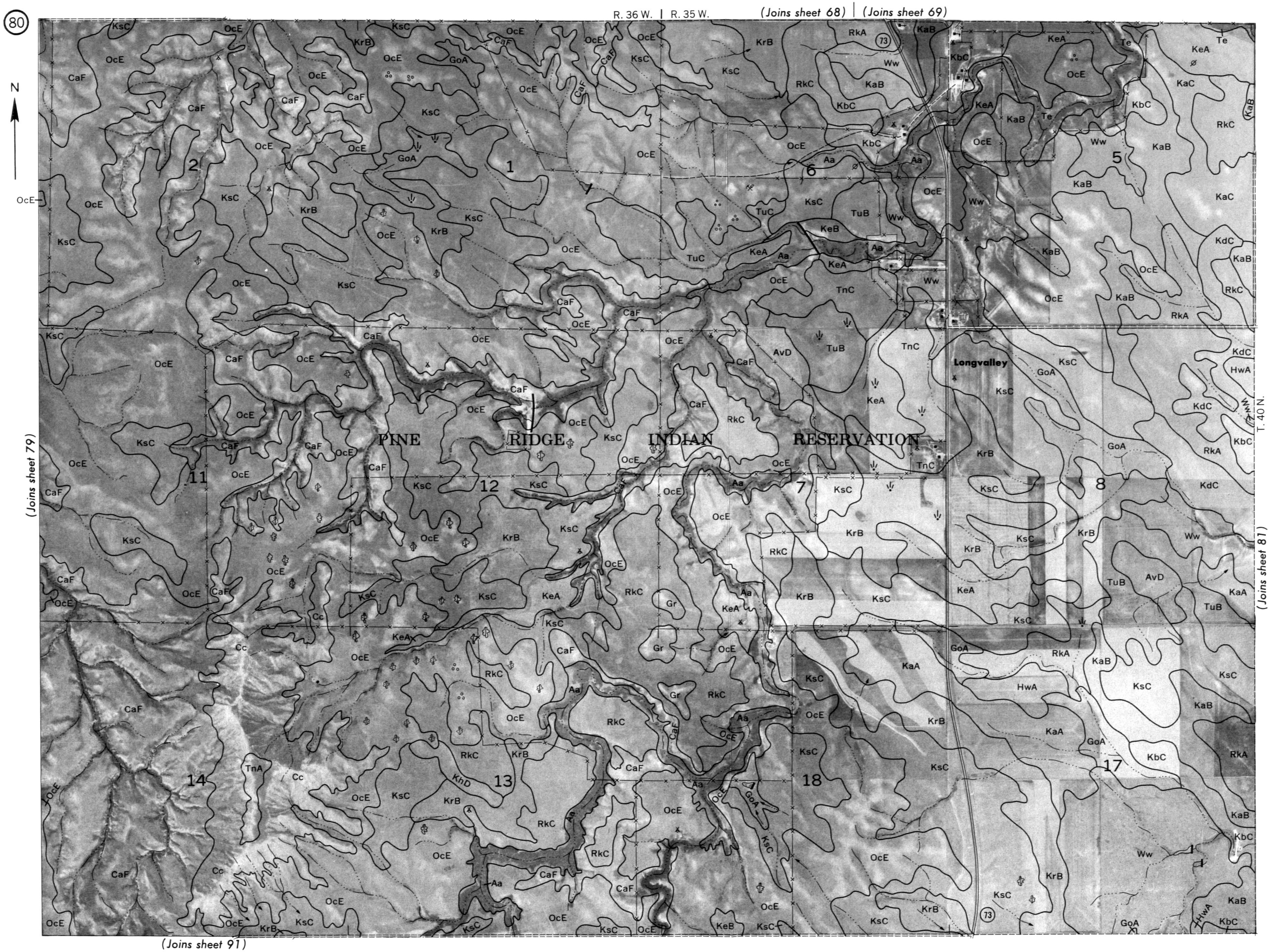
This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 79

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

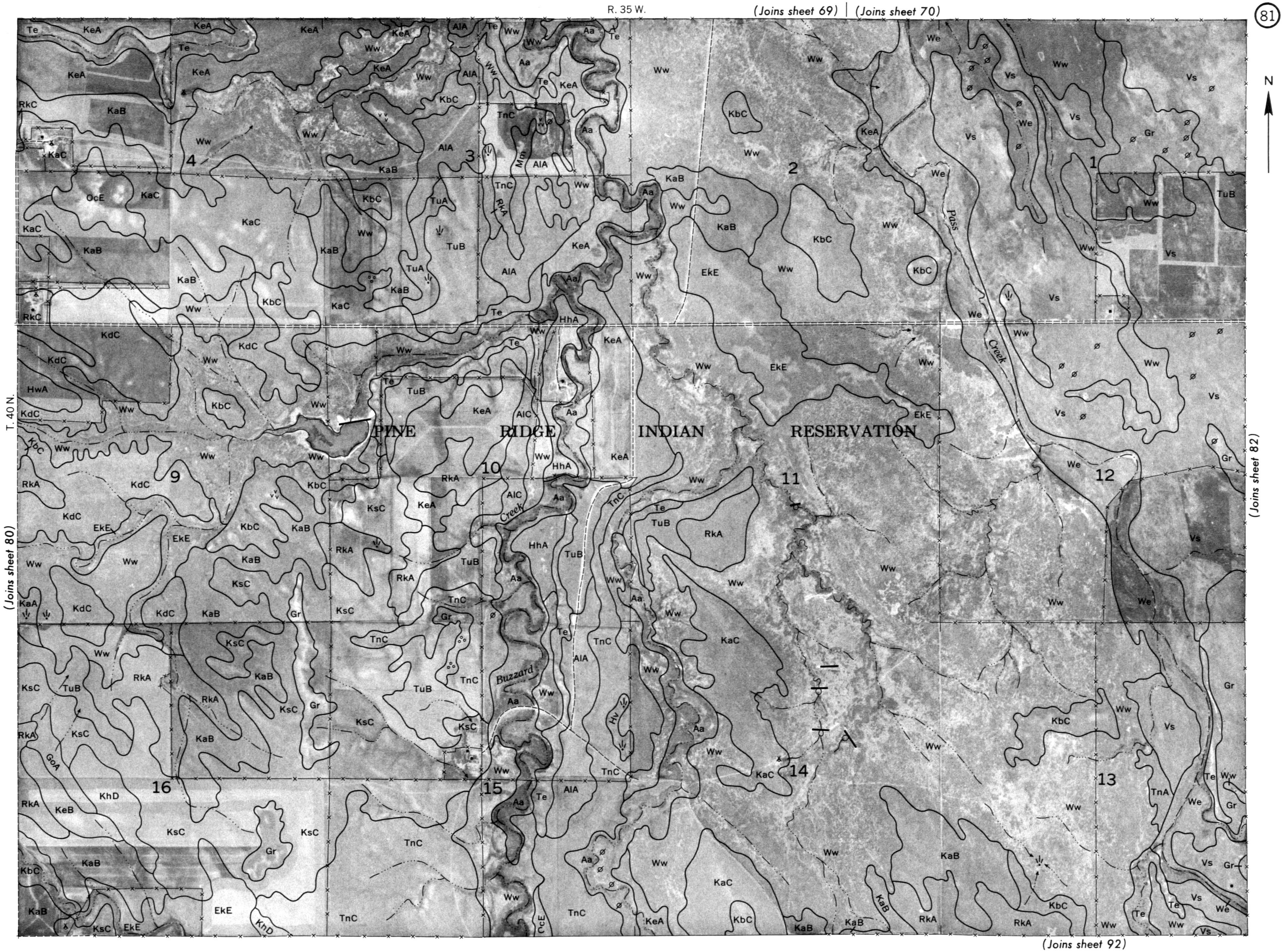


0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 80

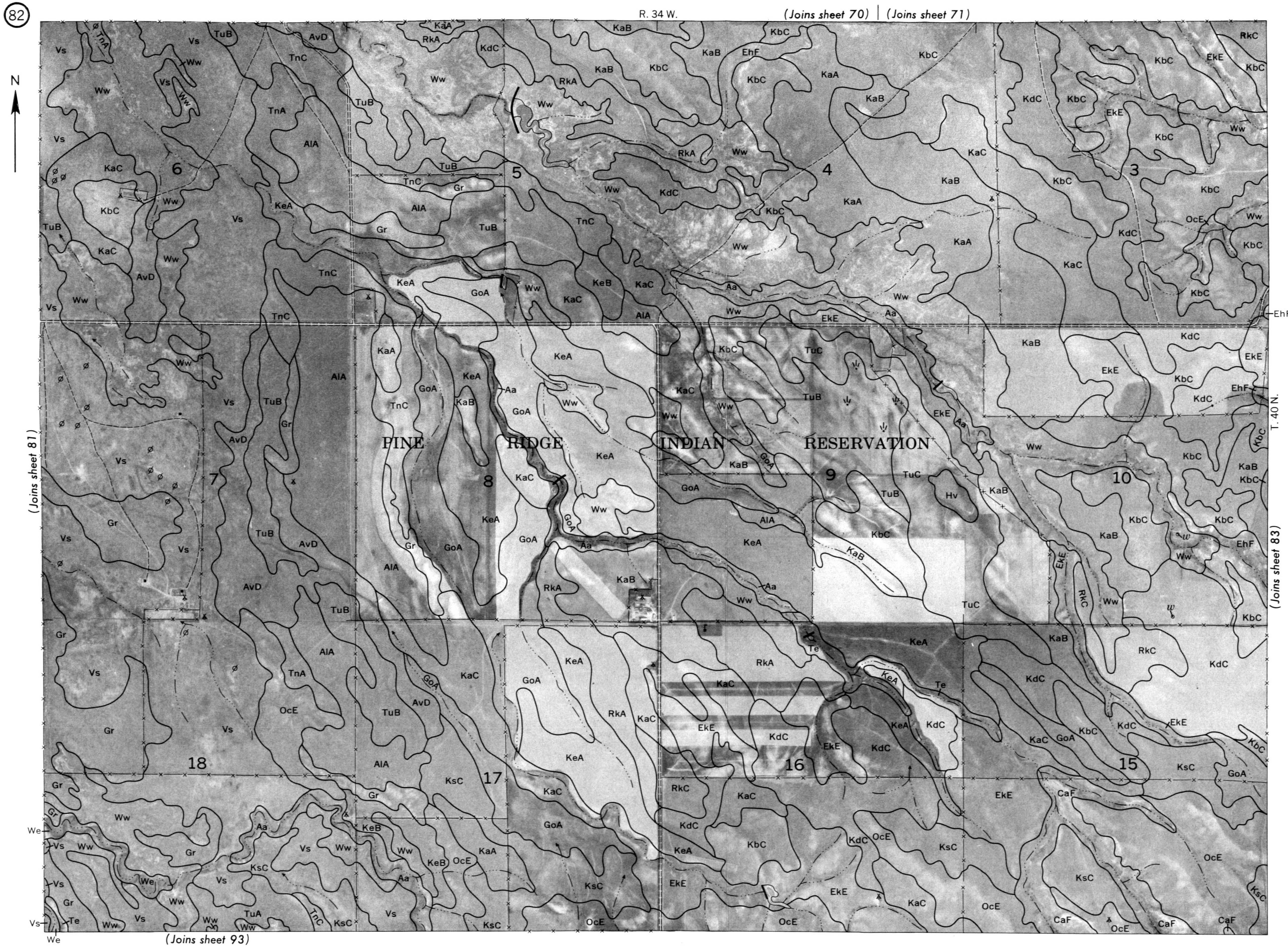
Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, Bureau of Indian Affairs, United States Department of the Interior, and the South Dakota Agricultural Experiment Station.
Land division corners are approximately positioned on this map.



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 82

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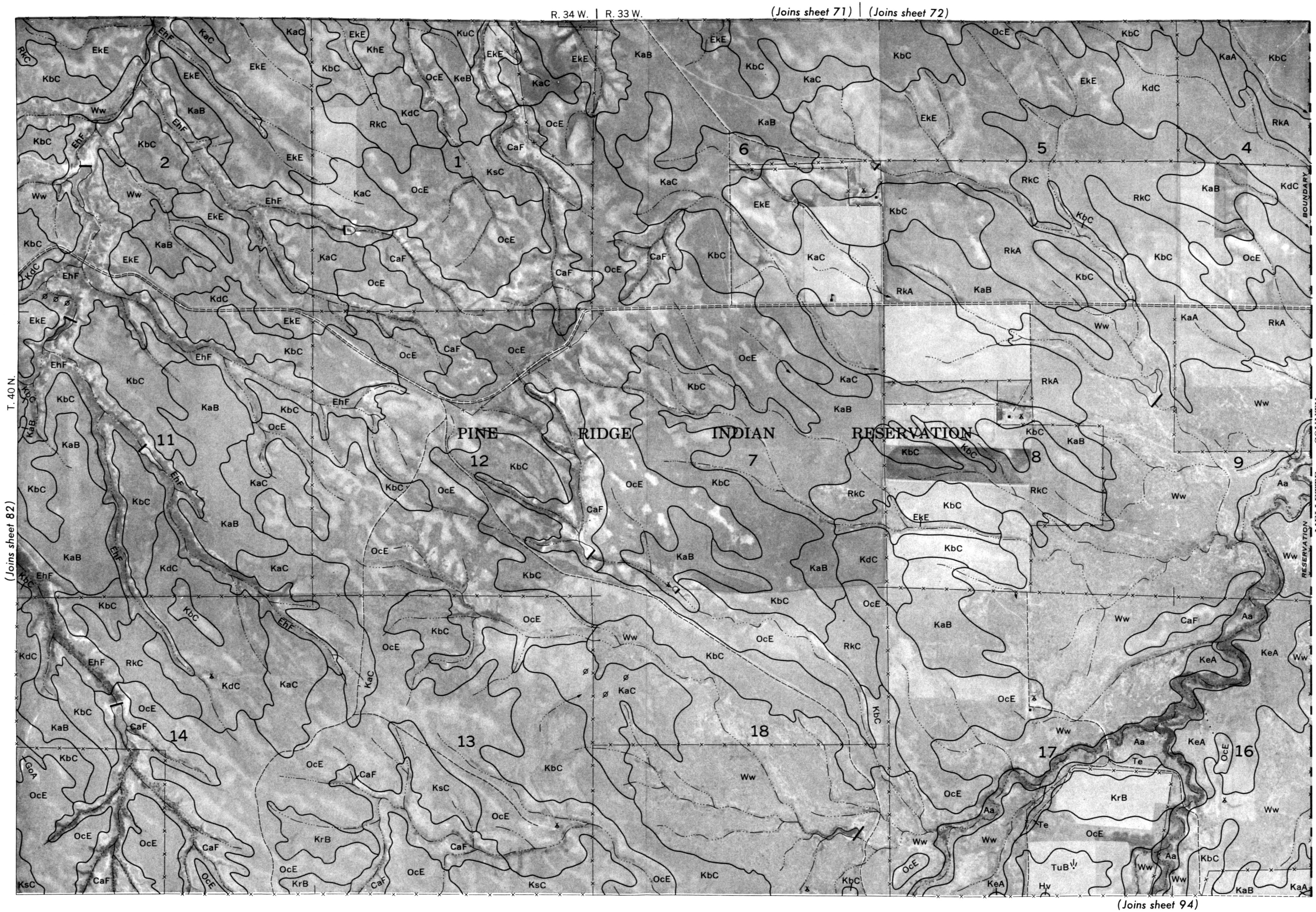
83



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

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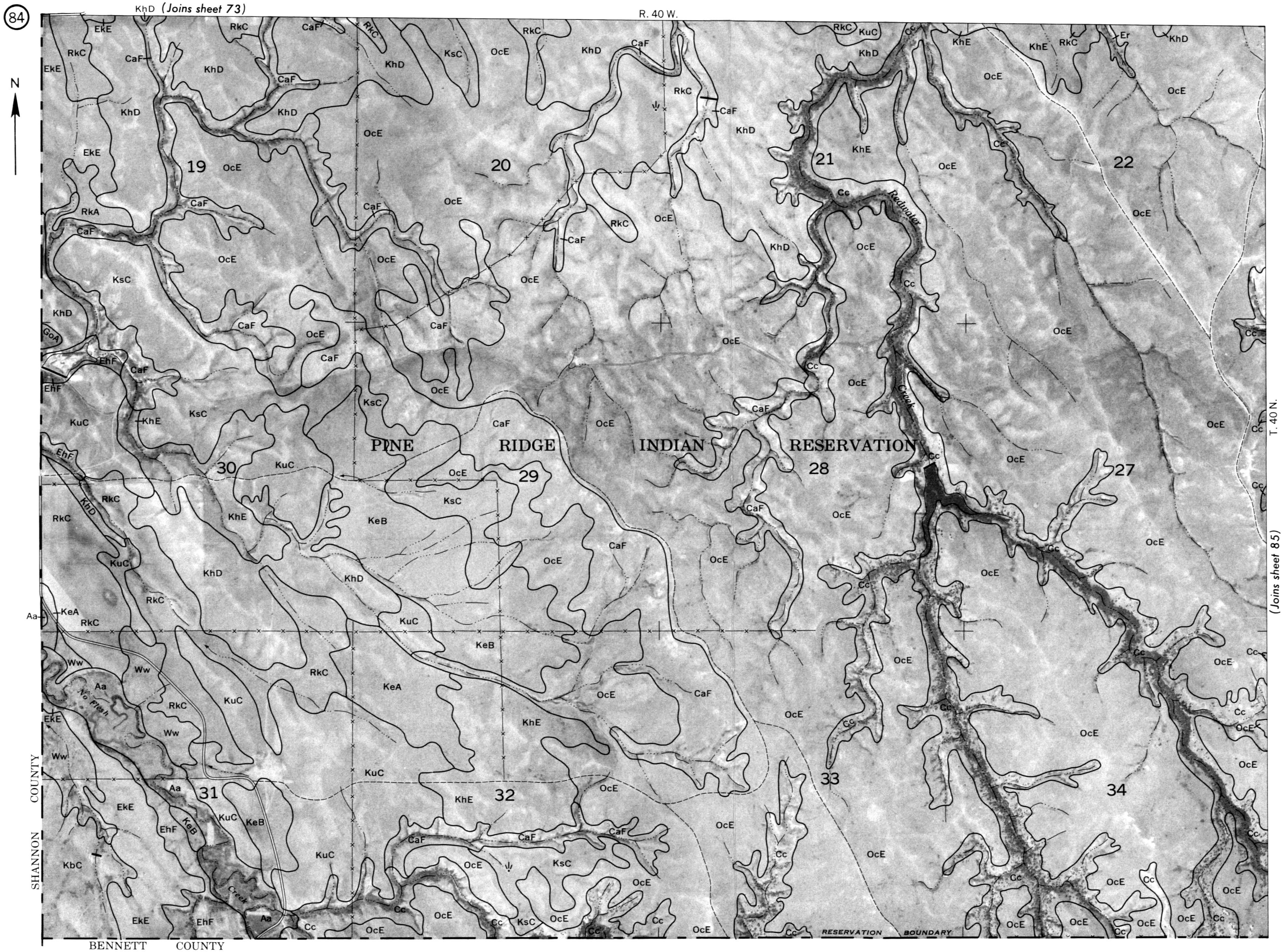
WASHABAUGH COUNTY, SOUTH DAKOTA NO. 83



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 84

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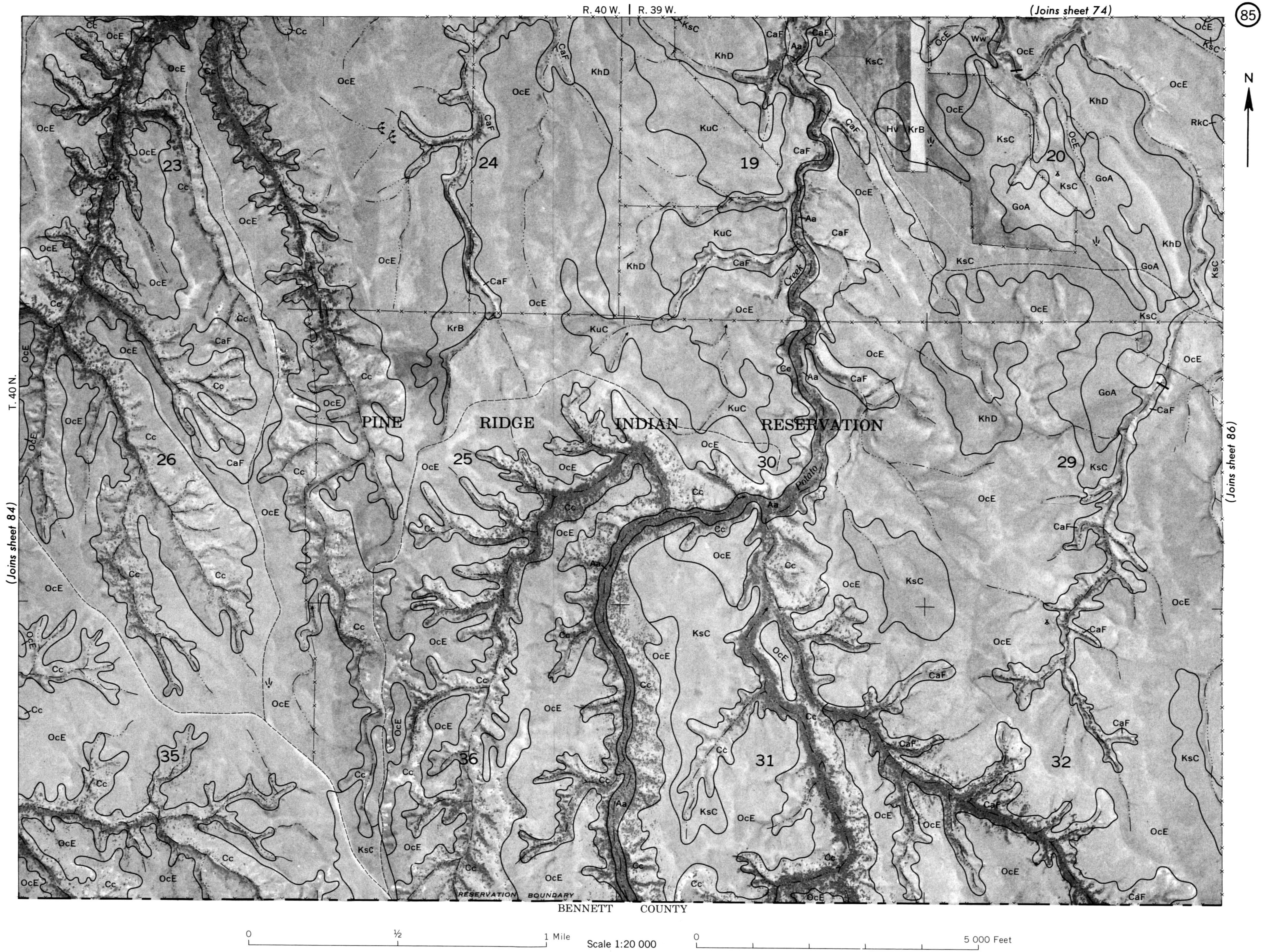

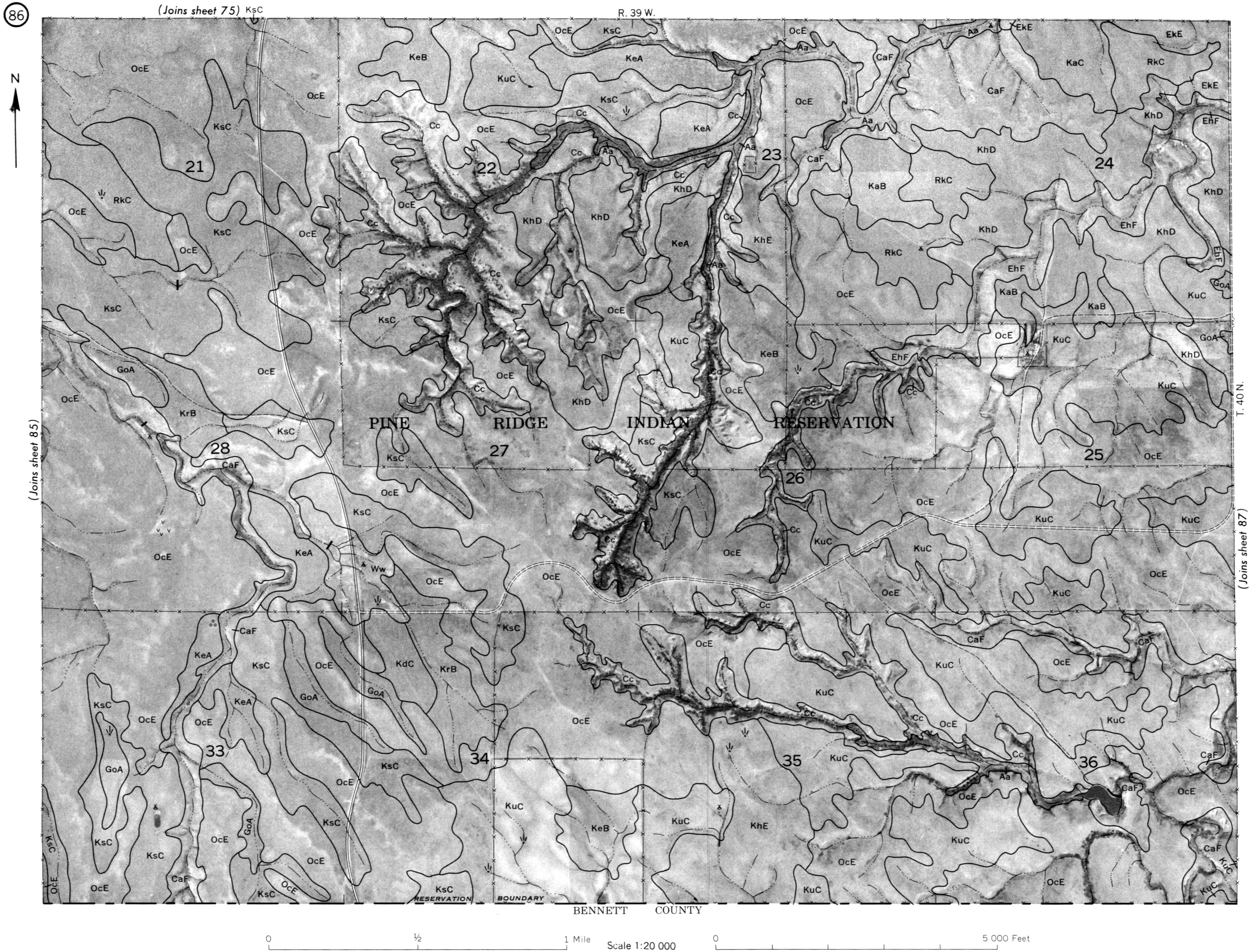

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 86

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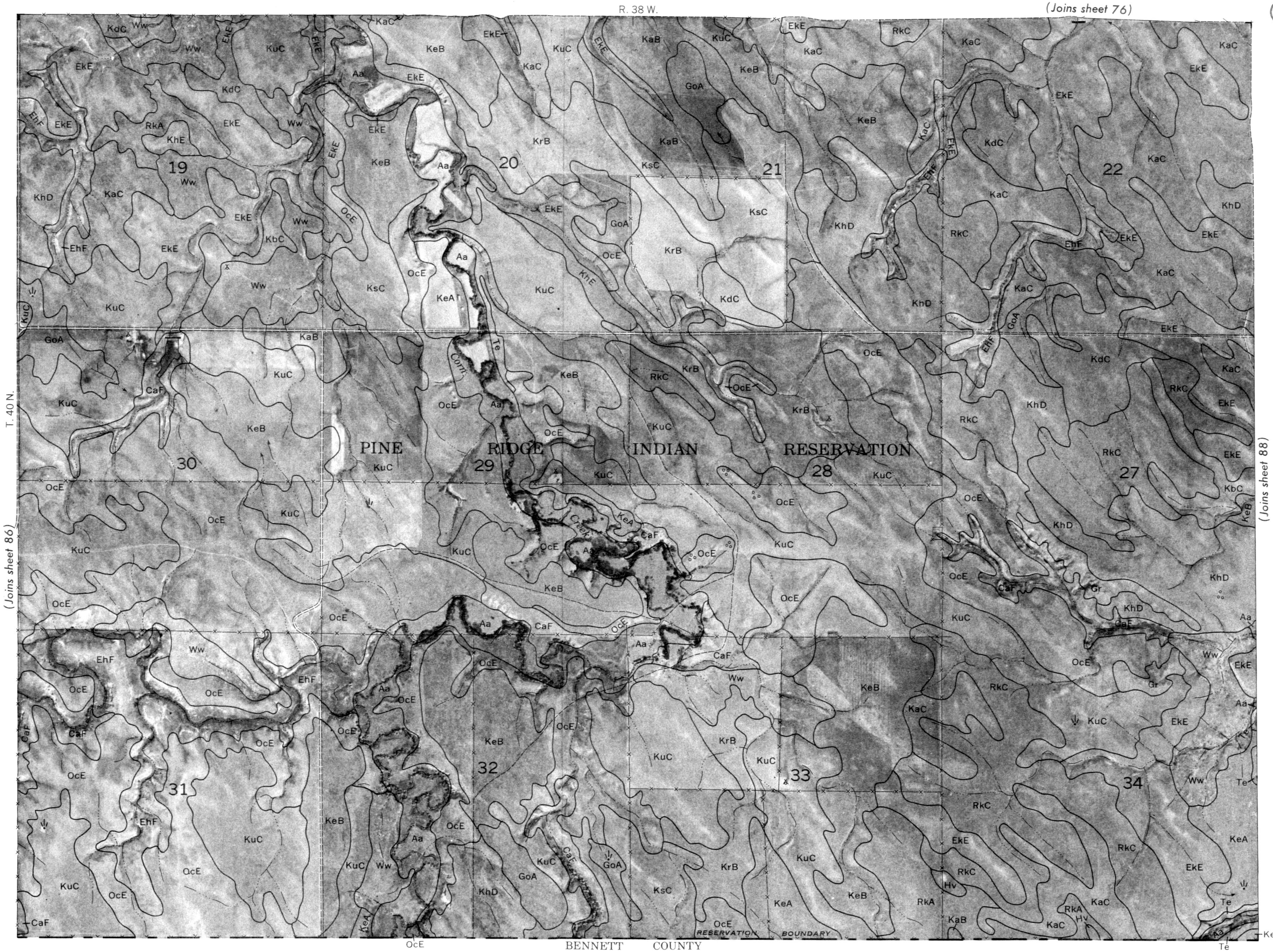
WASHABAUGH COUNTY, SOUTH DAKOTA NO. 87



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

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WASHABAUGH COUNTY, SOUTH DAKOTA NO. 88

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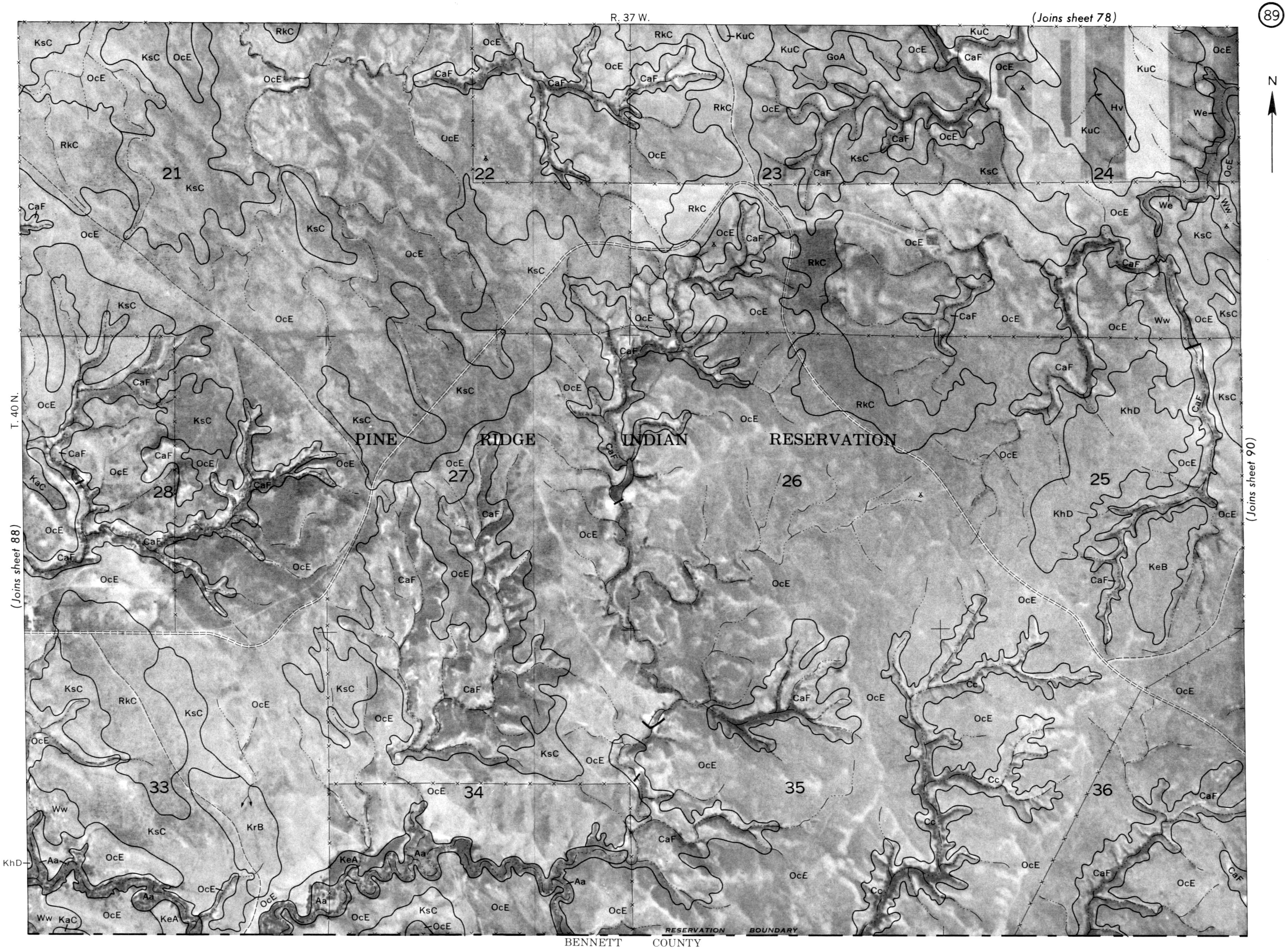
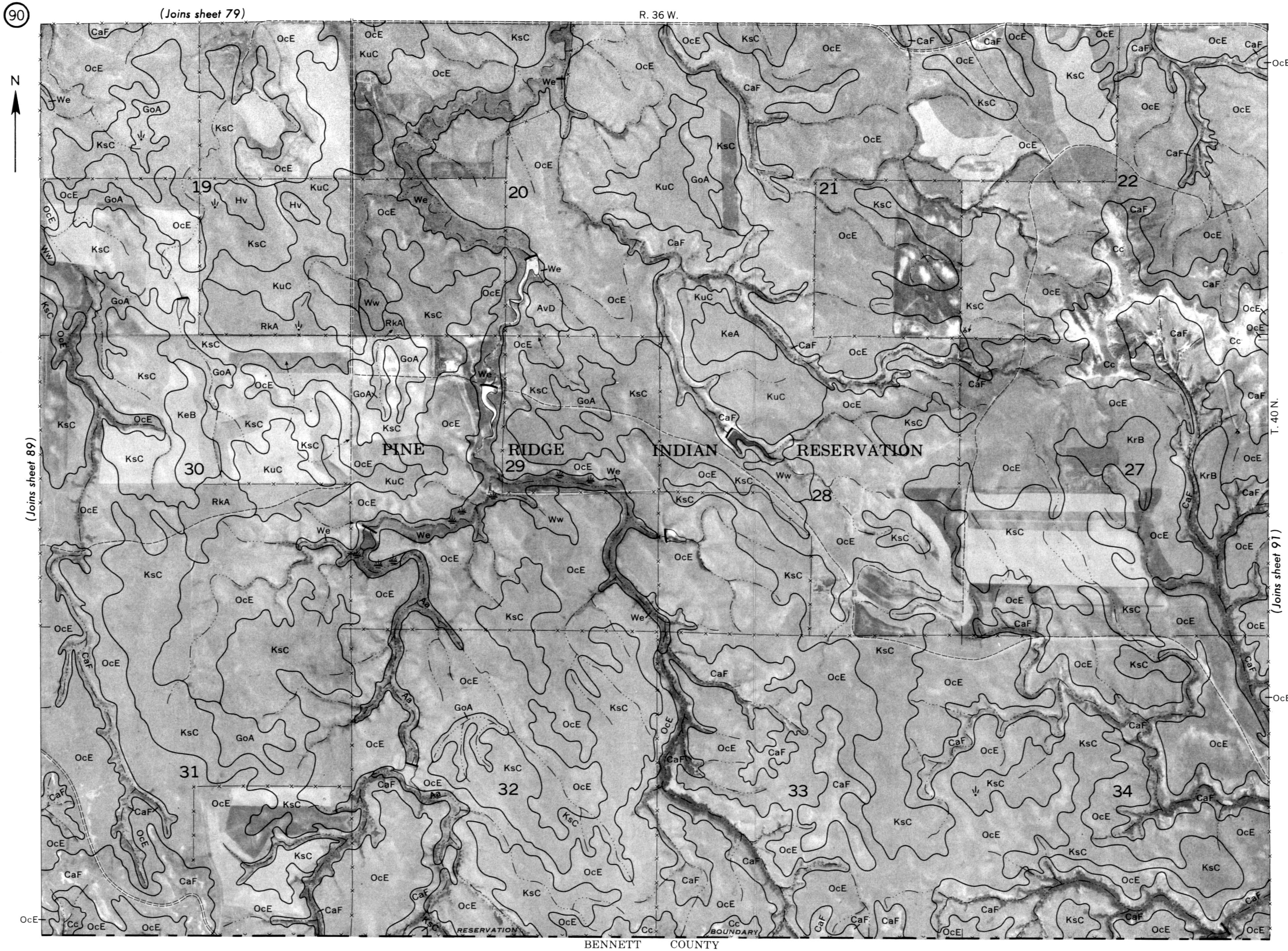
WASHABAUGH COUNTY, SOUTH DAKOTA NO. 89



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 90

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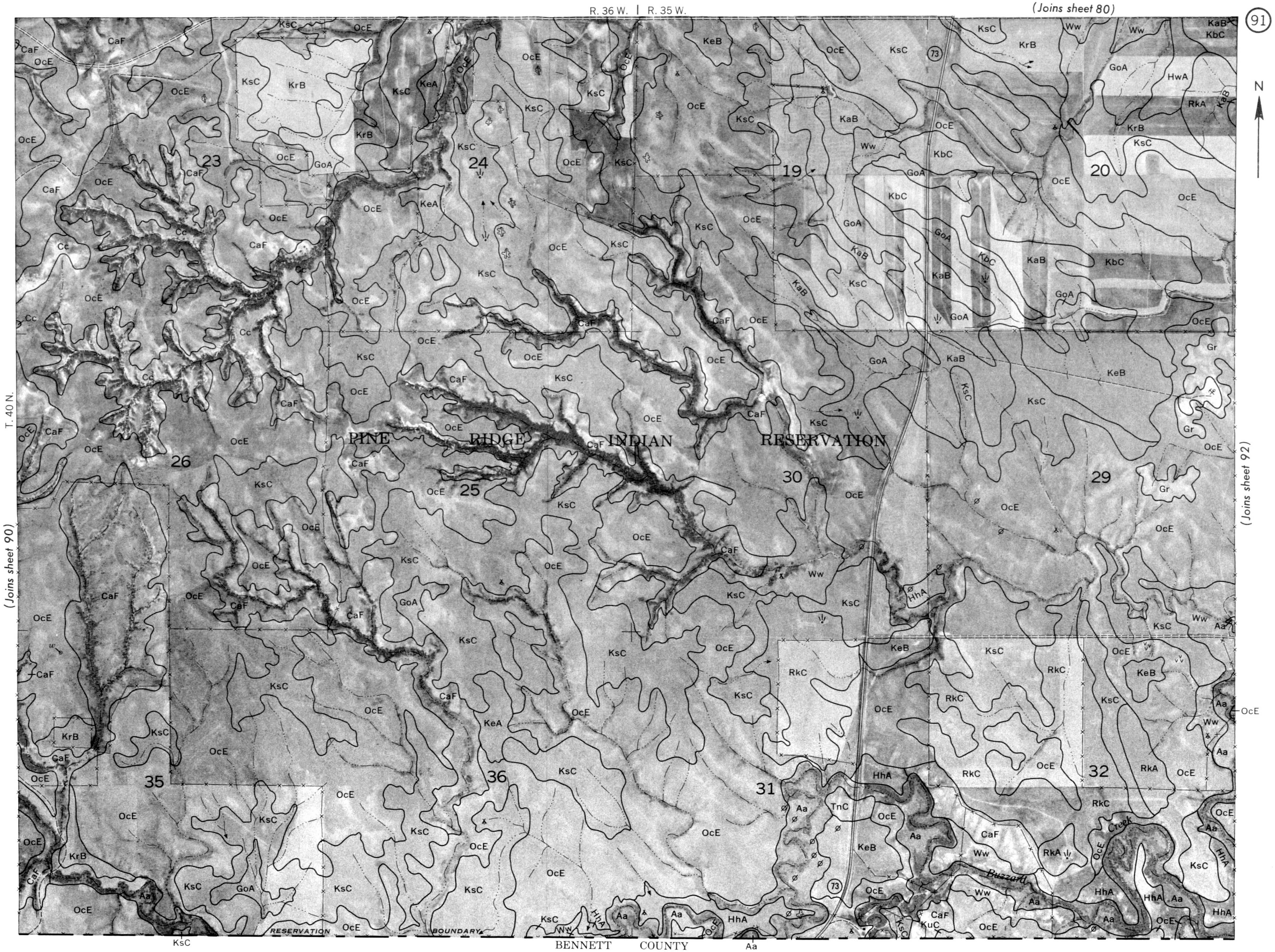

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

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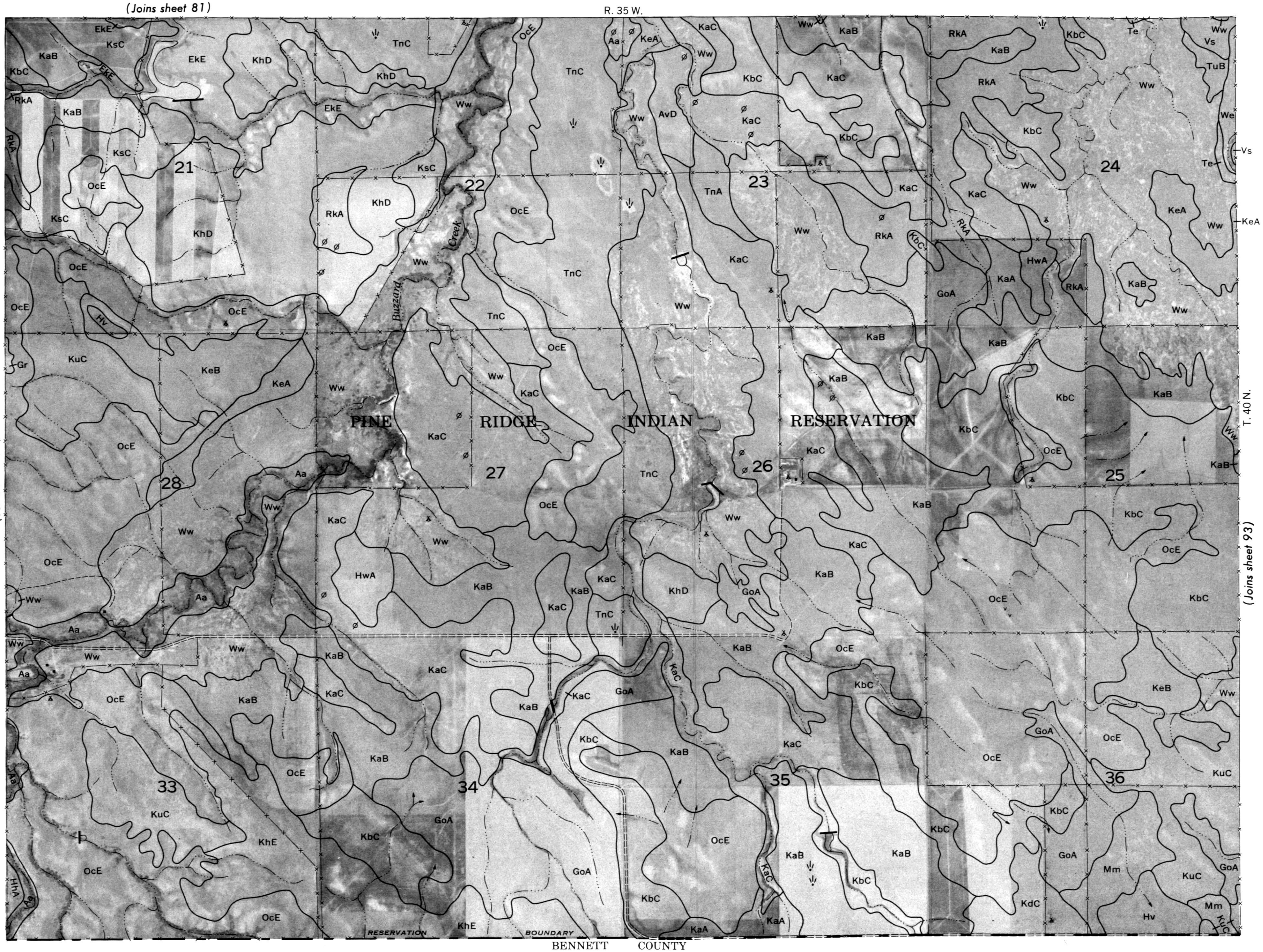
92



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WASHABAUGH COUNTY, SOUTH DAKOTA NO. 92

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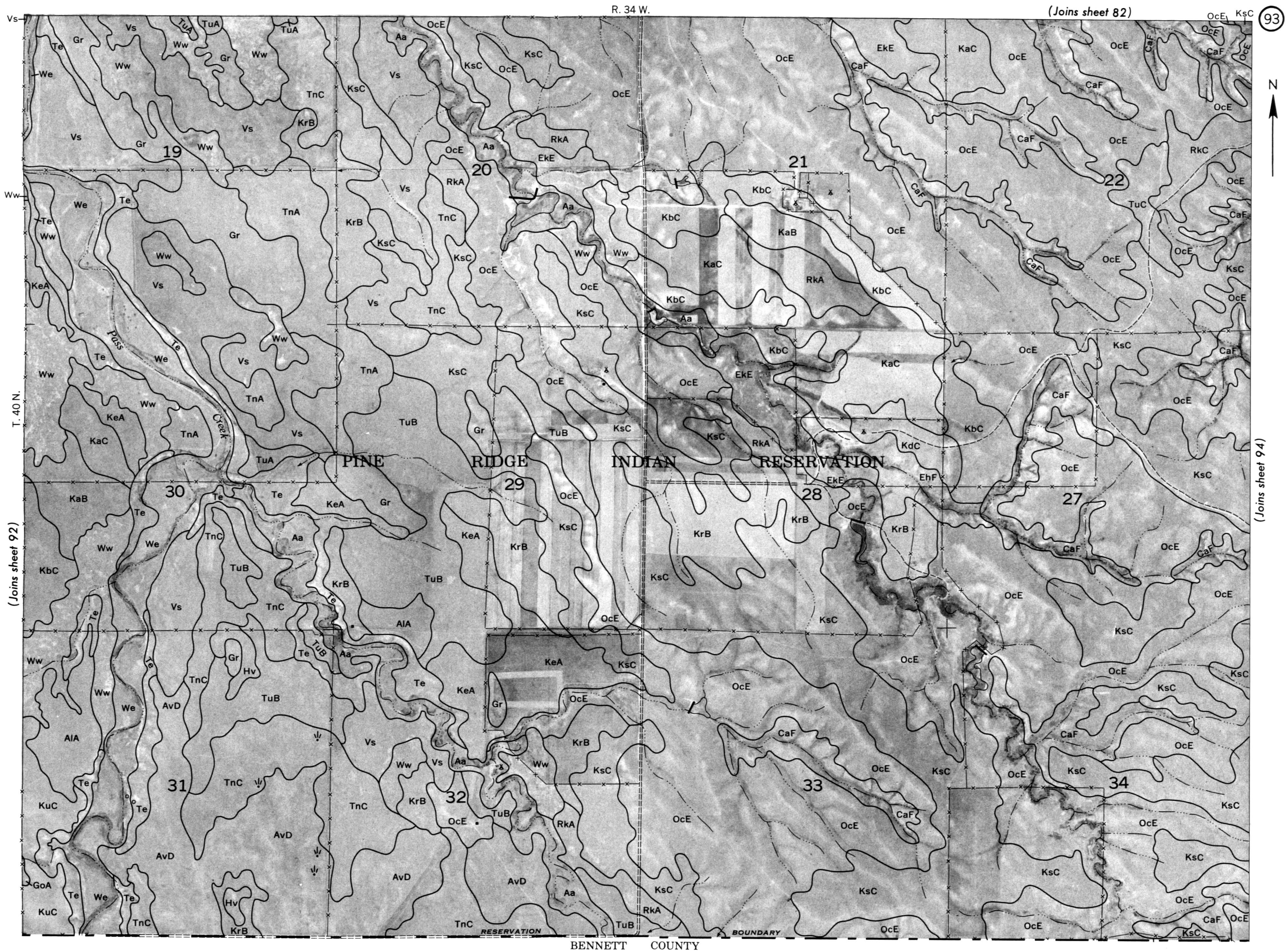

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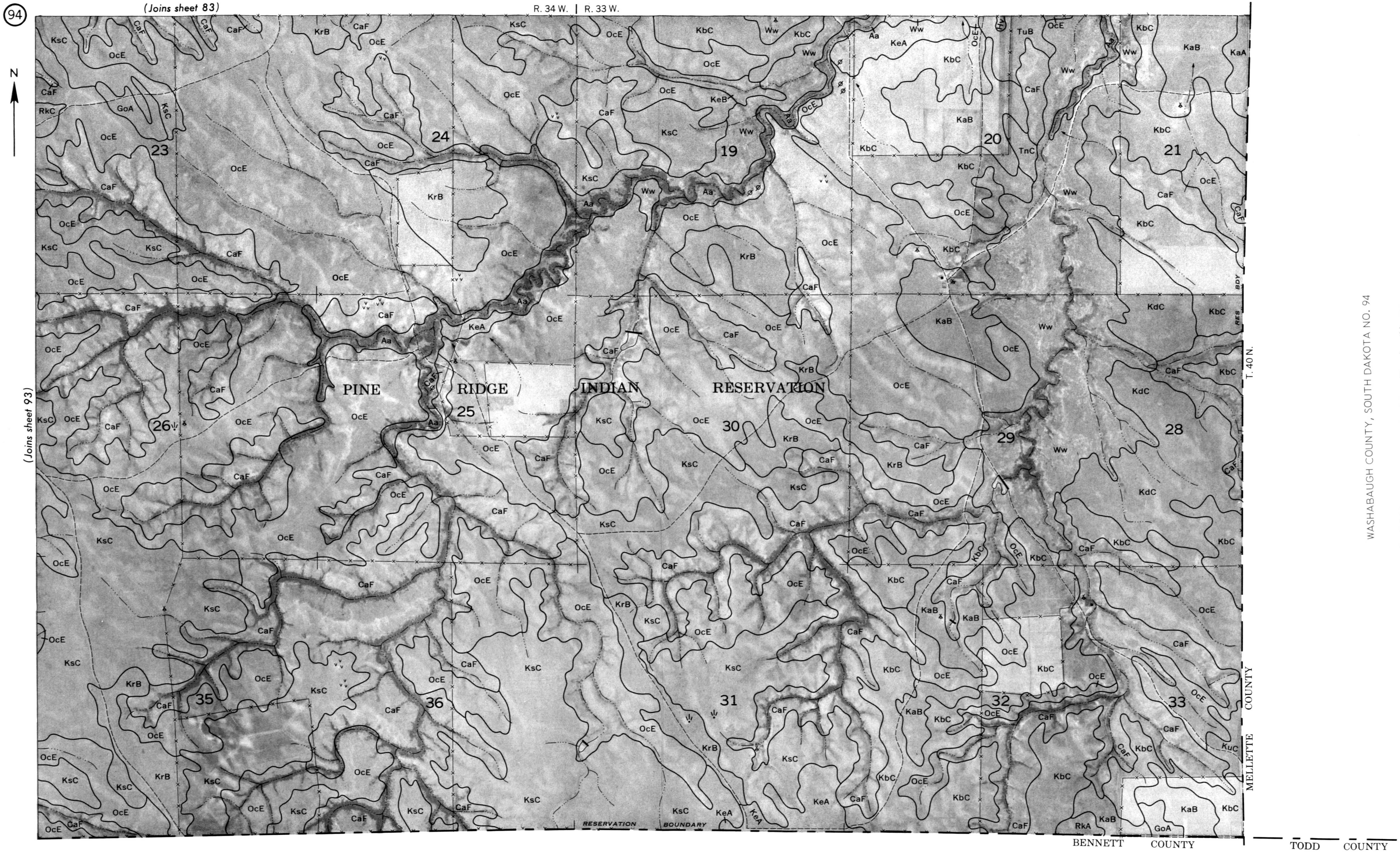
WASHABAUGH COUNTY, SOUTH DAKOTA NO. 93



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

WASHABAUGH COUNTY, SOUTH DAKOTA NO. 94

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